Clean Water Act 316(b) Proposal for Information Collection for Mirant's Contra Costa Power Plant

Submitted In Compliance with 316(b) Regulatory Requirements for Cooling Water Intake Structures at Phase II Existing Facilities

April 2006

Mirant Delta, LLC

Submitted to:

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AFB	Aquatic Filter Barrier
BA	Biological Assessment
BTA	Best Technology Available
CCPP	Contra Costa Power Plant
CDS	Comprehensive Demonstration Study
CDFG	California Department of Fish and Game
CESA	California Endangered Species Act
COE	Army Corps of Engineers
CWP	Circulating Water Pump
EPA	Environmental Protection Agency
ESA	Endangered Species Act
GPM	Gallons Per Minute
HCP	Habitat Conservation Plan
HRSG	Heat Recovery Steam Generator
ISO	Independent System Operator
MGD	Millions of Gallons per Day
NMFS	National Marine Fisheries Service
NMFS BO	National Marine Fisheries Service Biological Opinion
NPDES	National Pollutant Discharge Elimination System
PGE	Pacific Gas and Electric
PIC	Proposal for Information Collection
PPP	Pittsburg Power Plant
RMR	Reliability Must Run
Water Board	Regional Water Quality Control Board, Central Valley Region
SBDMP	Striped Bass Density Monitoring Program
TIOP	Technology Installation and Operation Plan
USFWS	U.S. Fish and Wildlife Service
USFWS BO	U.S. Fish and Wildlife Service Biological Opinion
VSD	Variable Speed Drive
VFD	Variable Frequency Drive

EXECUTIVE SUMMARY

This Proposal for Information Collection (PIC) for the Contra Costa Power Plant (CCPP) owned by Mirant Delta LLC (Mirant) is submitted in compliance with (1) the final Clean Water Act 316(b) Phase II Rule (Phase II Rule) for existing electric generating stations promulgated by Environmental Protection Agency (EPA) on July 9, 2004 (40 CFR §§ 122 et seq.; 69 Fed. Reg. at 41576, July 9, 2004), and (2) the October 3, 2005, letter from Mirant to the Central Valley Regional Water Quality Control Board (Water Board) requesting a schedule for submitting information required by the Phase II Rule. The PIC provides the Water Board:

- a description of the proposed and/or implemented technologies, operational measures, and restoration measures to be evaluated;
- a list and description of any historical studies characterizing impingement mortality and entrainment, and/or the physical and biological conditions in the vicinity of the cooling water intake structure;
- a summary of any past or ongoing consultations with relevant Federal, State, and Tribal fish and wildlife agencies; and
- a sampling plan for a new impingement study.

It is anticipated that the facility's Units 6& 7 will operate at a combined capacity utilization rate less than EPA's criteria of 15% (See Table 2-5). Because the capacity utilization rate is anticipated to be below 15% for the relevant 5-year period preceding the submittal of the Phase II studies, the entrainment standard will not be applicable to the CCPP. However, Mirant also recognizes the need to meet California's electric demand, and consequently there is a possibility that capacity utilization in 2006 and/or 2007 could increase to a level that would subject the CCPP to the entrainment reduction performance standard. In such an event, Mirant plans to demonstrate that it already has a combination of technologies, operational, and restoration measures in place to meet the applicable entrainment reduction standard of 60 to 90%.

The Phase II Rule allows for use of a credit toward compliance under the calculation baseline for operational or design measures that reduce entrainment and impingement. Mirant believes that the CCPP has met the entrainment mortality reduction through the retirement of CCPP Units 1-5 and use of closed-cycle cooling for Unit 8.[1] The retirement of Units 1-5 and planned use of closed-cycle for Unit 8 have reduced entrainment by an estimated 68.5%. The retirement of Units 1-5, use of closed-cycle cooling for Unit 8, and the installation and year-round operation of VFDs combined with annual flow caps (which were proposed in a Biological Assessment

[1] Although Unit 8 has not yet been completed, it is subject to the Phase II Rule because construction commenced in 2001 and therefore it is considered part of the existing facility. *See* 69 Fed. Reg. at 41578.

prepared for U.S. Army Corps of Engineers in August 2004[2]) and the existing restoration efforts will also generate a significant credit toward the impingement mortality reduction standard. Impingement studies planned for initiation in 2006 will be used to estimate the credit for the impingement reductions.

Mirant will be required to meet the Phase II Rule's impingement mortality reduction standard of 80 to 95% because the through-screen velocity of the Units 6&7 cooling water intake structure exceeds EPA's criteria of 0.5 fps. While CCPP will also achieve a substantial credit toward the impingement mortality reduction performance standard as a result of use of flow reduction measures and VFD pumps, at this point it is not yet clear if the impingement mortality reduction performance standard is met.

In the event that the impingement performance standard is not met, Mirant will be evaluating the full range of compliance options offered by the Phase II Rule to reduce impingement mortality. Technologies that provide impingement mortality reduction benefit will be evaluated. In addition, Mirant plans to evaluate use of restoration measures.[3] The use of selected technologies and site-specific standards will also be evaluated in combination with the restoration alternative as discussed in Section 3.0 of this PIC. The primary technologies that will be evaluated to meet the impingement mortality performance standards are wide-slot (9.5 mm) wedgewire screens, coarse mesh (9.5 mm) Ristroph traveling screens, barrier net, diversion systems, more frequent or continuous screen rotation, and behavioral devices. Due to the extensive flow reduction measures used at CCPP, it will be especially important to evaluate use of site-specific standards under Compliance Alternative 5.

This PIC also provides a schedule consistent with the schedule set forth in the October 3, 2005 (Schedule Request Letter) to the Water Board that accompanied the application for renewal of CCPP's NPDES Permit No. CA0004863, Order No. 5-01-107, as updated by Mirant's March 2, 2006, letter to the Water Board.[4]

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[2] Mirant Delta, LLC. 2004. Biological Assessment for the Contra Costa and Pittsburg Power Plants. Prepared in conjunction with Mirant Delta, LLC's nationwide permit applications for maintenance dredging at the Contra Costa and Pittsburg Power Plants. Submitted to the Army Corps of Engineers, U.S. Fish and Wildlife, NOAA Fisheries, California Department of Fish and Game, Regional Water Quality Control Board, Bay Conservation and Development Commission, and U.S. EPA.

[3] The use of restoration measures to comply with the Phase II Rule's performance standards is currently the subject of litigation challenging certain aspects of the Phase II Rule. Petitions in several federal appeals courts, including the Ninth Circuit Court of Appeals, challenging the Phase II Rule have been consolidated and transferred to the Second Circuit Court of Appeals, and are currently pending in *Surfrider Foundation et al. v. EPA*. The Court has issued a briefing schedule and final oral briefings are currently scheduled for April 24, 2006. It is anticipated the Court will render a final decision prior to leaving for summer recess at the end of August. Therefore, it is likely that any impact of that decision on the currently available compliance alternatives and compliance options can be considered in making Mirant's final compliance decision.

[4] See Letter to Gary M. Carlton, Executive Officer of the Central Valley Regional Water Quality Control Board, from Rob A. Hayes, President, Mirant Delta, LLC dated October 3, 2005 requesting Clean Water Act Section 316(b) Phase II Rule compliance schedule NPDES Permit No. CA0004863, Order No. 5-01-107; and Letter to Jon Ericson, Water Resources Control Engineer, Central Valley Regional Water Quality Control Board, from Steve Bauman, Sr. Environmental Engineer, Mirant Delta, LLC, dated March 2, 2006.

1.0 INTRODUCTION

EPA promulgated new requirements for existing electric power generating facilities to comply with Clean Water Act Section 316(b) on July 9, 2004. *See* 69 Fed. Reg. at 41576. These regulations, known as the Phase II Rule, became effective on September 7, 2004 and establish numeric performance standards. 40 CFR § 125.94(b). The Phase II Rule provides facilities with five Compliance Alternatives as follows:

1. A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality performance standard (the entrainment standard, applicable still applies).

2. A facility can demonstrate that it already has a combination of technologies, operational measures, and restoration measures in place to meet the applicable performance standards.

3. A facility can propose to install a combination of new technologies, operational measures, and restoration measures to meet applicable performance standards.

4. A facility can propose to install, operate, and maintain an approved design and construction technology.

5. A facility can request a site-specific determination of best technology available (BTA) by demonstrating that either the cost of installing technologies, operational measures, and restoration measures are either significantly greater than the cost for the facility listed in Appendix A of the rule or significantly greater than the benefits of complying with the applicable performance standards. 40 CFR § 125.94(a)(1-5).

All facilities that use compliance alternatives 2, 3, and 4 are required to demonstrate a reduction in impingement mortality between 80% and 95%. 40 CFR § 125.94(b)(1). Facilities must also reduce entrainment by 60% to 90% if they have a capacity factor that is greater than 15% and (1) are located on oceans, estuaries or the Great Lakes or (2) are located on rivers and have a design intake flow that exceeds more than 5% of the river's mean annual flow. 40 CFR § 125.94(b)(2). The Phase II Rule further requires facilities selecting compliance alternatives 2, 3, and 5 to prepare a Comprehensive Demonstration Study (CDS). 40 CFR § 125.95(b). Facilities using Compliance Alternative 1 are not required to submit a CDS, and those using Compliance Alternative 4 are only required to submit the Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. 40 CFR § 125.95(b). All facilities that use compliance alternatives 2, 3 and 5 are required to prepare and submit a PIC, the first component of the CDS. The PIC must include:

1. A description of the proposed and/or implemented technologies, operational measures, and restoration measures to be evaluated.

2. A list and description of any historical studies characterizing impingement mortality and entrainment, and/or the physical and biological conditions in the vicinity of the cooling water intake structures and their relevance to this proposed Study. If you propose to use existing data, you must demonstrate that the data are representative of current conditions and were collected using appropriate quality assurance/quality control procedures.

3. A summary of any past or ongoing consultations with relevant Federal, State, and Tribal fish and wildlife agencies and a copy of written comments received as a result of each consultation.

4. A sampling plan for any new studies the facility plans to conduct in order to ensure that you have sufficient data to develop a scientifically valid estimate of impingement mortality and entrainment at the site. The sampling plan must document all methods and quality assurance/quality control procedures for sampling and data analysis. The sampling and data analysis methods proposed must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area (including the area of influence of the cooling water intake structure), and provide a taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish). 40 CFR § 125.95(b)(1).

The preamble to the Phase II Rule states that the PIC should provide other information, where available, regarding plans for preparing the CDS such as how the facility plans to conduct a Benefits Valuation Study or gather additional data to support development of a Restoration Plan. 69 Fed. Reg. at 41635.[5]

[5] The Phase II Rule acknowledges that some of these studies may require an iterative process, and that, for example, a facility may not be able to design a Benefits Valuation Study and determine what additional data are needed (e.g., quantified information on non-use benefits) until it has first collected and analyzed the data for its impingement mortality and/or entrainment characterization study. 69 Fed. Reg. at 41635.

2.0 DESCRIPTION OF CONTRA COSTA POWER PLANT

The CCPP, owned and operated by Mirant, is located on the estuarine reach of the San Joaquin River near the city of Antioch in Contra Costa County, California (Figures 2-1, 2-2).[6] The CCPP consists of seven natural gas-fired generating units. In 2001, Unit 8 was permitted and construction began. Construction was suspended in 2002, and is anticipated to resume in 2006. Units 1-3 and accompanying small house generating units were built in 1951 and retired in 1995. Units 4&5 were built in 1953 and, though they are no longer operated to generate electricity, they are currently operated as synchronous condensers to improve power reliability. Units 6&7 were built in 1964 and generate a total of 690 gross megawatts (gMW) of power. Unit 8 has a planned generating capacity of 530 gMW.[7] The energy output and design flows for CCPP Units 1-7 and combined-cycle Unit 8 are summarized in Table 2-1.

Units 6&7 are equipped with once through cooling which utilizes water withdrawn from the estuarine reach of the San Joaquin River; Unit 8 will reuse water discharged from either Unit 6 or Unit 7. Source waters for the CCPP cooling water system are characteristic of this part of the Estuary that separates the upstream, freshwater Delta from the downstream, saltwater bays. As built, the total cooling water design flow required to service Units 1-7 combined was approximately 685,200 gallons per minute (gpm), or 986.5 million gallons per day (MGD). Units 6&7 are each serviced by two circulating water pumps (CWP) that each have a design flow of 152,800 gpm, or 220 MGD (Table 2-1). The total design flow for both Unit 6 and Unit 7 is approximately 305,600 gpm, or 440 MGD.

In addition to the Unit 6 and Unit 7 cooling water intake requirements, the CCPP utilizes water for station water supplies, for intermittent intake screen washing, and for fire suppression purposes. At maximum operation, these additional uses account for approximately 22 MGD. The total current design flow for all CCPP operations, including Unit 8, is approximately 462 MGD (Table 2-2). Thus the proportion of design intake flow used for cooling purposes in the cooling water system is 95% (i.e., 440/462).

The number of days the cooling water system is in operation varies depending on the demand of California's electricity transmission grid. However, CCPP Unit 7 has been designated as a Reliability Must-Run (RMR) priority electrical generation unit by the California Independent System Operator (ISO). CCPP is important to the overall stability of the San Francisco Bay

[6] Based on salinity levels of approximately 2 parts per thousand, the source water for the CCPP, though referred to as the San Joaquin River, is actually an "estuary" for the purposes of the Phase II Rule. 40 CFR § 125.93.

[7] The Phase II Rule's preamble states that an existing facility is one that commenced construction as described in 40 CFR section 122.29(b)(4) on or before January 17, 2002.69 Fed. Reg. at 41578. Since Unit 8 was permitted and construction initiated in 2001 it is part of the existing Phase II facility.

Area electrical grid. Under the terms of the RMR contract, CCPP Unit 7 must be available to provide 100% generating capacity if such power is required by the ISO at any time.

Further, CCPP Units 6&7 are both considered "Participating Generators" by the Federal Energy Regulatory Commission. The ISO set forth an implementation plan directing all non-hydroelectric generators to offer all available generation to the ISO real-time market at all times. Thus, CCPP Units 6&7 must offer generation during all hours if it is available and not already scheduled to run under another agreement.

Details of each of the water withdrawal systems are provided in the following sections.

Table 2-1. Electrical output and design cooling water flows for CCPP prior to 1995.

	Unit								
	1[(1)]	**2**[(1)]	**3**[(1)]	**4**[(2)]	**5**[(2)]	**6**	**7**	**Unit 8**	**Total**
Design Capacity (gMW)	113	113	113	122	120	345	345	**530**[(3)]	**1,801**
Current/Planned Capacity	0[(5)]	0[(5)]	0[(5)]	0[(5)]	0[(5)]	345	345	**530**	**1,220**
Design Flow (gpm)	89,600	89,600	89,600	55,400	55,400	152,800	152,800	**0**[(4)]	**685,200**
Design Flow (MGD)	129	129	129	80	80	220	220	-	**987**
Current/Planned Design Flow (gpm)	0	0	0	0	0	152,800	152,800	-	**305,600**
Current/Planned Design Flow (MGD)	0	0	0	0	0	220	220	-	**440**

(1) House units for Units 1-3 provided up to 27 gMW auxiliary power for internal use.

(2) Units 4 and 5 are currently used as synchronous condensers and the cooling water flows are provided by station service water.

(3) Unit 8 will generate 530 gMW when construction is completed.

(4) Unit 8 is designed to reuse water after circulation through Unit 6 or Unit 7. The table reflects the assumption that Unit 8 will operate at the same time that Unit 6 or Unit 7 operates and no additional water use is attributed to Unit 8. If Units 6&7 are not being operated, 38,200 gpm of water would be withdrawn through a single existing circulating water pump operating at half-speed to provide make-up cooling water to compensate for Unit 8 evaporation losses.

(5) Units 1-5 were retired in 1995.

Table 2-2. Total current CCPP design flow water use by subsystem.

	Flow (gpm)	Flow (MGD)
Circulating Water Pumps(1)		
Unit 6	152,800	220
Unit 7	152,800	220
Subtotal	305,600	440
Continuous Pumps		
Station Service Pumps	12,000	17.28
Jockey Pump (Fire Suppression)	20	0.029
Subtotal	12,020	17.309
Intermittent Pumps		
Units 6&7 Screenwash Pumps (2)	5,400	3.888
Fire Suppression (Main Pump) (3)	2,000	0.72
Subtotal	7,400	4.608
TOTAL	**325,020**	**462**

(1) Unit 8 is designed to reuse water after circulation through Unit 6 or Unit 7. The table reflects that Unit 8 will operate at the same time that Unit 6 or Unit 7 operates and no additional water use is attributed to Unit 8. If Units 6&7 are not being operated, 38,200 gpm of water would be withdrawn through a single existing circulating water pump operating at half-speed to provide make-up cooling water to compensate for Unit 8 evaporation losses.

(2) Assumes that all three screenwash pumps operate for two hours every four hours per day.

(3) The fire suppression pumps are always available for emergency situations. The normal operating flows are based on testing each pump up to one hour per week to assure pump reliability and to occasionally flush the header system. Flows are calculated assuming the main pump is used for 25% of the year.

2.1 Units 1-5 Cooling Water Intake System

Cooling water for Units 1-5 was historically withdrawn from the estuarine reach of the San Joaquin River at a point approximately 250 ft offshore through two 12-ft-diameter intake tunnels, which delivered cooling water to a conventional screenhouse onshore (Figure 2-3). The intake, at the offshore point of water withdrawal, is located at 38°01'14 North and longitude 121°45'45" West. The intake conduits rest on the bottom of the Estuary at a depth of approximately 22 ft below Mean Sea Level (MSL). Units 1-5 were retired in 1995 and no longer withdraw cooling water through the Units 1-5 intake structure. Units 4&5 are currently used as synchronous condensers, a function that does not require water from the Plant's circulating water pumps. When the Units 1-5 circulating water pumps were operated, flow through the intake structure was up to 550 MGD. With retirement of Units 1-5, the maximum daily flow through the intake structure is 10 MGD (less than 2% of the original flow), which is provided by station service water (see Section 2.4).

The Units 1-5 intake consists of bar racks and traveling screens. Two bar racks, each approximately 26 ft 9.5 in. long and spaced 3.75 in. on center are located about 250 ft in front of the vertical traveling screens and prevent the entry of large objects into the cooling water system. Five vertical traveling screens with a mesh size of 3/8 in. retain smaller objects. Each traveling screen is approximately 10 ft 4.75 in. long and 2 ft wide, and is comprised of screened “panels”. Units 1-5 traveling screens no longer operate since only the low volume station service water is withdrawn through the structure.

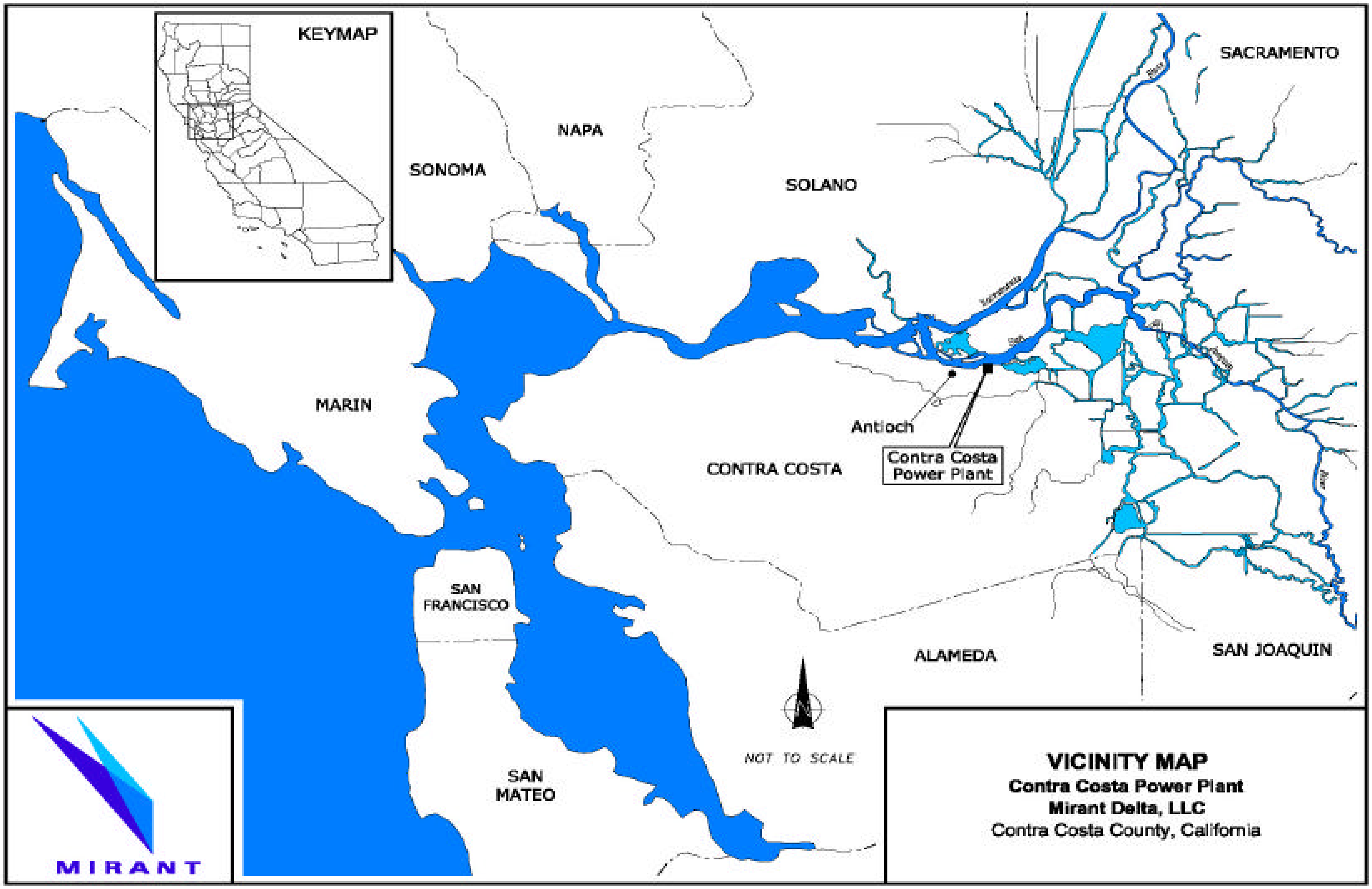

Figure 2-1. Overview of the Bay-Delta showing the location of the Contra Costa Power Plant.

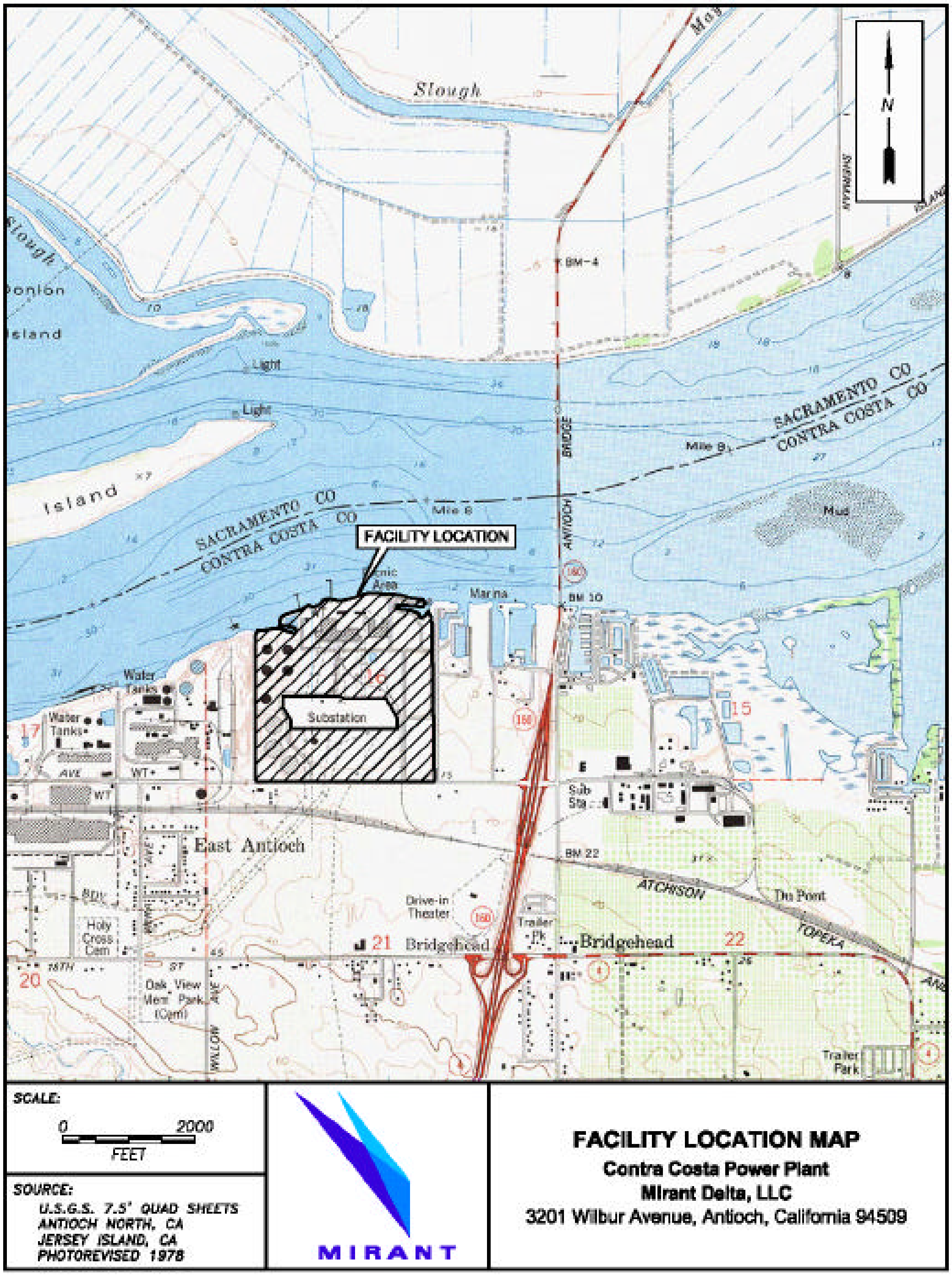

Figure 2-2. Property boundary of the Contra Costa Power Plant.

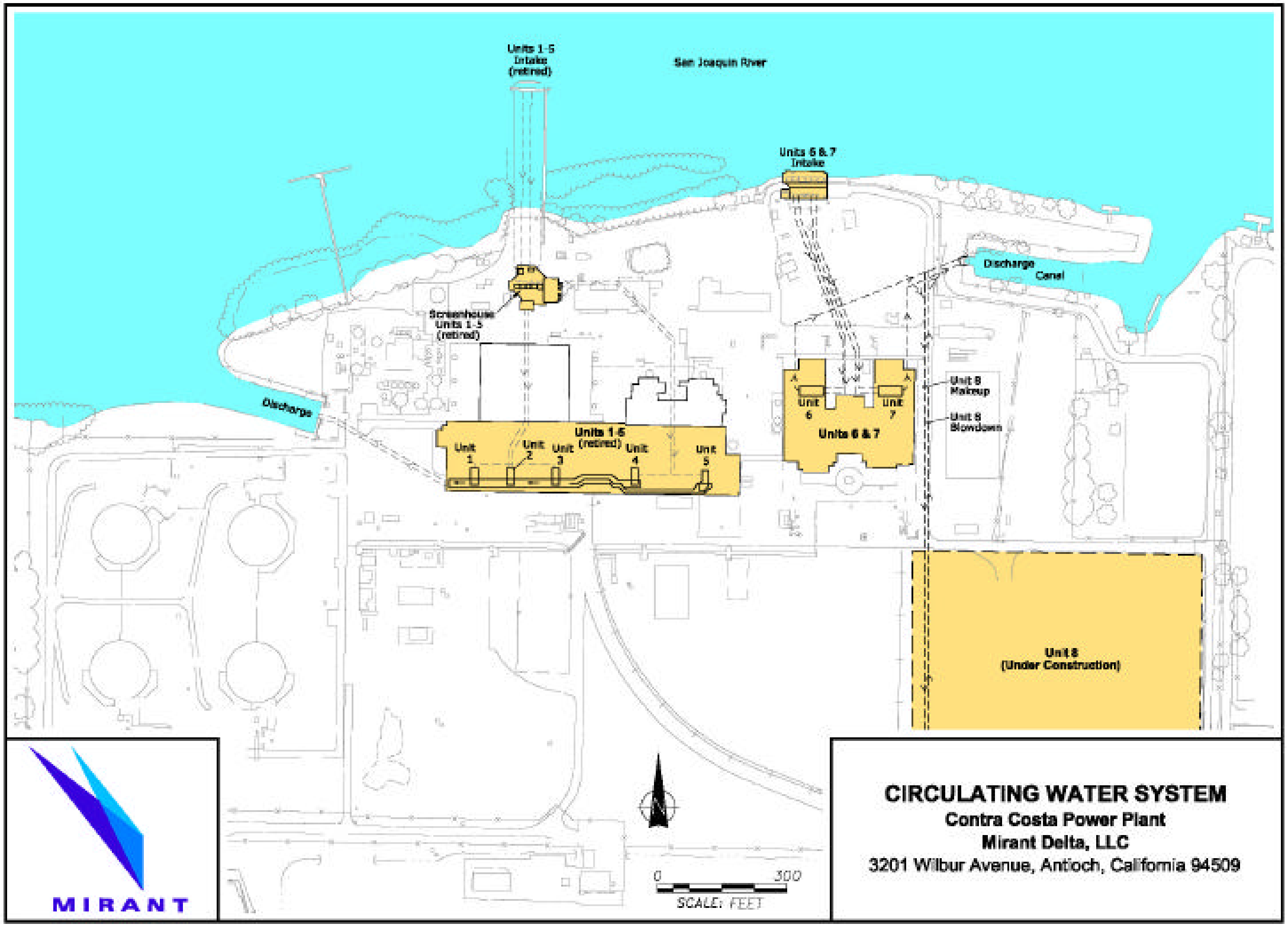

Figure 2-3. General configuration of the Contra Costa Power Plant cooling water system.

Each of the units was equipped with two circulating water pumps that supplied cooling water to the unit's steam condenser. Units 1-3 circulating water pumps had a capacity of 44,800 gpm each, and those serving Units 4&5 had a capacity of 27,700 gpm each.

Units 1-3 circulating water pumps also supplied cooling water to their respective house unit steam condensers. In addition, Units 1-3 had four 3,000-gpm auxiliary pumps (also referred to as station service pumps) that supply water for other unit needs. Two of the four auxiliary pumps usually provided an adequate supply of water for these other needs. Under design maximum operating conditions, the combined flow rate of Units 1-5 was 391,600 gpm. The volume of water from the auxiliary pumps constituted less than 3% of the Units 1-5 cooling water flow. The auxiliary pumps continue to supply water for Units 4&5 synchronous condenser operation, boiler water makeup, and other auxiliary system needs.

Table 2-3 provides design water velocities from several locations in the Units 1-5 intake structure. When all circulating water pumps were operating, the design water velocity through the traveling screens was 2.6 feet per second (fps).

Table 2-3. Design water velocities estimated at full circulating water pump flow for several locations throughout the Units 1-5 intake structure.

Location	Design Water Velocities (fps)
Through intake tunnel	3.8
Approach to bar racks	2.7
Through bar racks	3.6
Approach to screens	1.3
Through screens	2.6

2.2 Units 6&7 Cooling Water Intake System

The Units 6&7 intake structure is located on the shoreline approximately 600 ft east of the Units 1-5 intake structure (Figure 2-3). The bottom of the intake structure is approximately 14 ft below Mean Sea Level. The latitude and longitude coordinates of the Units 6&7 intake structure are 38°01'12" North and longitude 121°45'36" West. The intake facility is a concrete structure that includes bar racks, traveling screens, and circulating water pumps. Separate intake conduits deliver cooling water to the Unit 6 and Unit 7 condensers. The cooling water flows from each unit are kept separate from each other and are ultimately directed into a discharge channel. The discharge channel joins the Estuary approximately 800 ft east of the Units 6&7 intake structure.

The major features of the Units 6&7 intake structure are shown in Figure 2-4. Six bar racks, each approximately 22 ft long and spaced 4.0 in. on center, are located about 15 ft in front of the vertical traveling screens system and prevent the entry of large objects into the cooling water system. Six vertical traveling screens with a mesh size of 3/8 in. retain smaller objects. Each traveling screen is comprised of 30 screened “panels.” Each panel is approximately 10 ft wide and 2 ft tall.

Table 2-4 provides design water velocities from several locations in the Units 6&7 intake structure. When all circulating water pumps are operating at full flow, the design water velocity through the traveling screens is 1.5 fps.

Table 2-4. Design water velocities estimated at full circulating water pump flow for several locations throughout the Units 6&7 intake structure.

	Design Water Velocities (fps)
Approach to bar racks	0.6
Through bar racks	0.7
Approach to screens	0.8
Through screens	1.5

Debris, along with fishes and invertebrates retained by the screens, is removed during the screen rotation and washing, which is initiated either by a timer at about 4-hour intervals under normal operating conditions or when the across-screen hydraulic differential exceeds a predetermined maximum. The traveling screens are rotated and rinsed whenever the circulating water pumps are operating.

During screen washing, high-pressure (110-psi) spray nozzles wash debris and impinged organisms into a surrounding sluiceway that empties into a screen refuse sump. Two screen refuse pumps withdraw the impinged material by suction and convey it to the circulating water discharge tunnel. The pumps are vertical dry pit refuse pumps, centrifugal, enclosed impellers, which will pass a 6-inch diameter sphere.

The screenwash discharge is returned to the Estuary by large-diameter pumps. The centrifugal vertical open-impeller pumps are activated sequentially as the wet well fills with screenwash by pedestal float switches, and they run until the well is empty. The pumps discharge into an 18-in. diameter concrete pipe that empties into the discharge conduit of Unit 6.

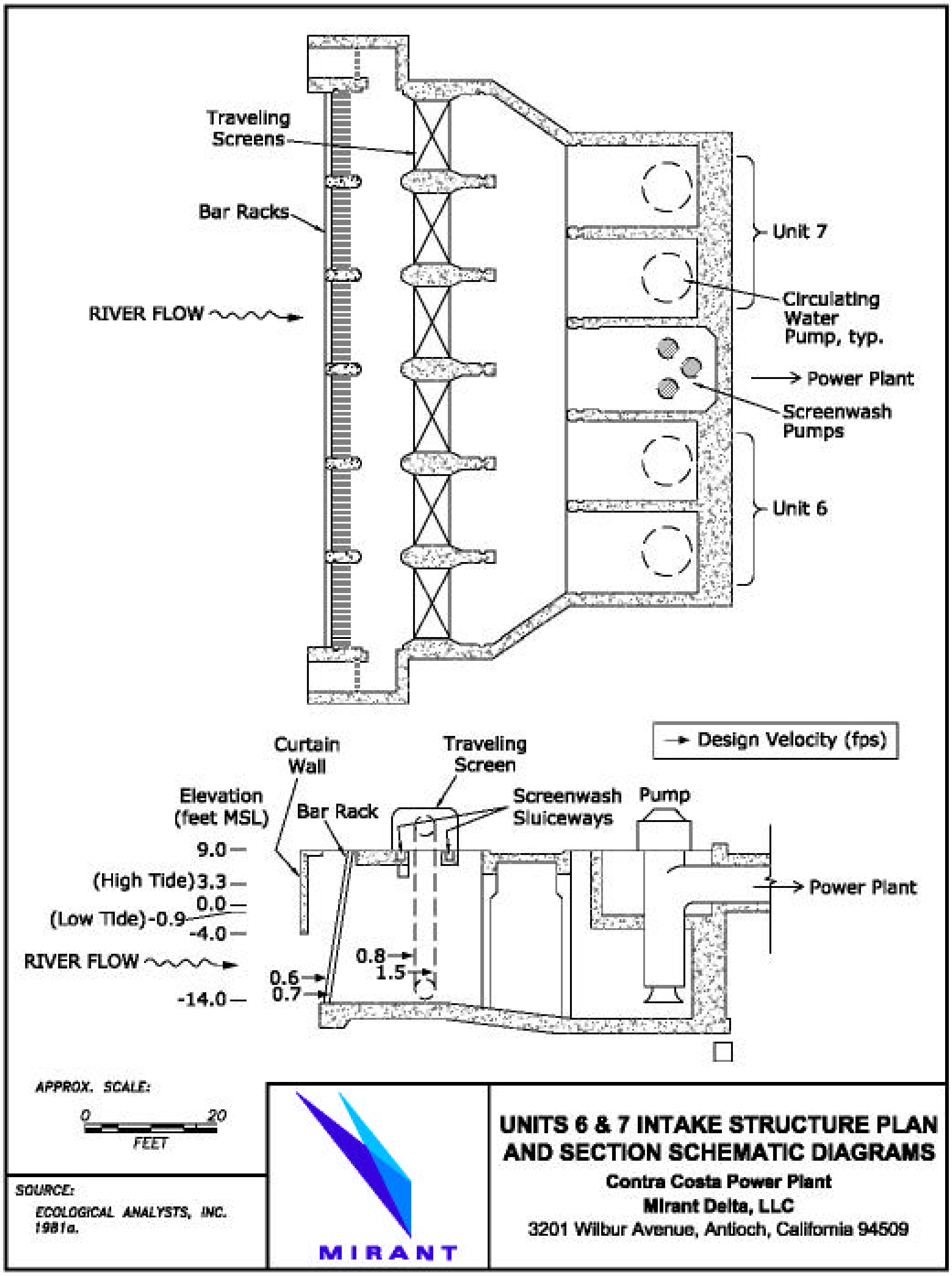

Figure 2-4. Plan and section schematic diagrams of the Contra Costa Power Plant Units 6&7 intake structure.

Each unit's two 76,400 gpm circulating water pumps are run simultaneously and furnish 305,600 gpm of cooling water to the Units 6&7 condensers. Single-pump operation occurs only during maintenance inspections and outages. In single-pump operation, electrical generation is limited to less than 50% of a unit's maximum capacity. These pumps were initially retrofitted with Variable Speed Drive (VSD) controls in 1987, allowing them to be operated from 50% to 95% of their rated capacity. In early 2004, the VSD controls were replaced with updated Variable Frequency Drive (VFD) technology. When operating in VFD mode, the CWP speed/flow is typically at its minimum level when the unit is at minimum load. The minimum CWP speed/flow is set at 50% of design flow. The minimum CWP speed/flow may vary due to the temperatures of the intake water or the cleanliness of the condenser tubes (commonly measured as backpressure). In general, the minimum speed/flow will be between 50–60% of design flow at loads less than 65 gross megawatts (gMW). As unit load increases, pump speed and flow are increased in accordance with unit conditions. The VFD control procedure is written as follows:

> There are two modes of VFD operation depending on the time of year. Generally, from May 1 to July 15, a feed forward curve controls the circulating water pump (CWP) speed at 50% speed until 172 MW is achieved. The speed then gradually ramps to 95% speed at 322 MW. The speed is maintained at 95% through a full load of 345 MW. A discharge temperature setpoint of 85ºF also cascades into the control logic to increase or decrease the pump speed as needed. The pump speed is always maintained for minimum flow and optimum temperature (<86ºF) in the range of 50 to 95% except in the rare occurrence when a condenser backpressure greater than 2.0 inches Hg is impacting the reliability of the unit. Except during conditions of electrical grid system reliability as dictated by the Independent System Operator (ISO), the unit load is reduced to prevent pump speed from exceeding 95% due to either exceeding a backpressure of 2.0 inches Hg or exceeding discharge temperature of 86ºF.
>
> During the remainder of the year, a feed forward curve maintains 50% of speed until 65 MW when the speed is gradually ramped to 95% at 115 MW. The 95% speed curve is maintained through full load at 345 MW. Turbine backpressure is cascaded into the control logic to allow a maximum backpressure of between 0.8 and 1.8 in Hg between 50 and 345 gross MW. Exceeding the turbine backpressure curve will allow the pump speed to exceed the feed forward curve.

2.3 Unit 8

The closed cooling water system designed to serve Unit 8 is depicted in Figure 2-3. This closed-cycle system is designed to use a mechanical-draft, wet cooling tower to dissipate the heat transferred to the cooling water flow during transit through the steam condensers. In a closed-cycle system, "makeup" water is withdrawn from a source to replace cooling water that evaporates in the cooling tower or is carried away in small droplets (drift) and to control the dissolved solids content of the cooling water. The portion of the cooling water returned to the source water body, with its typically higher concentration of minerals, is called blowdown. The ratio of the water returned (blowdown) to water withdrawn (makeup) depends on a number of factors affecting the rate of evaporation, including air temperature, humidity, and wind.

The new unit includes a closed-cycle mechanical draft cooling tower utilizing a maximum of 7,630 gpm of make-up water from the existing discharge water of cooling water from Units 6 and/or 7. With the retirement of Units 1-5, design circulating water flows are 440 MGD, with an additional 22 MGD for auxiliary systems. Unit 8's reuse of Units 6&7 cooling water will not increase the volume of water withdrawn from the Estuary. Unit 8 will draw its cooling water supply from the existing cooling water flow of Units 6&7. In the event Units 6&7 are not operating when Unit 8 is in operation, one circulating water pump will run at reduced speed/flow. The reduced flow will be the lowest pump flow possible (38,200 gpm) to provide the minimum cooling tower make-up water required at the time (maximum 7,630 gpm) plus sufficient flow to meet the NPDES flow relationship for Outfall 002 (15%). The utilization of Unit 8 will thus greatly reduce the amount of cooling water withdrawn from the Estuary.

CCPP Unit 8's combined cycle power unit consists of two natural gas-fired combustion turbine generators, two heat recovery steam generators (HRSGs), and a steam turbine generator. In the combined cycle process, electricity is created from the combustion turbines and the steam turbine. Natural gas is burned to fire the combustion turbines. Exhaust heat from the two combustion turbines is then used to generate steam in the HRSG, which in turn drives the steam turbine electricity generator. The combined cycle process creates electricity more efficiently and creates less pollution than conventional power systems.

2.4 Station Service, Intake Screenwash, and Fire Suppression Water Systems

There are three relatively low-volume or intermittent-use water systems at the CCPP that withdraw Delta water in addition to the cooling water system of Units 6&7. These three systems are the station service, intake screenwash, and fire suppression water systems.

The station service water system withdraws water from the Units 1-5 intake structure for use as bearing cooling water for Units 4&5 synchronous condensers and for the water treatment systems for Units 6, 7, and 8. There are a total of four station service water pumps each having a design-rated capacity of 3,000 gpm. During normal operation, one pump is operated continuously for 24-hours per day to provide a total of 3,000 gpm of station service water. Maximum station service water flows would be with four pumps operating at a total of 12,000 gpm.

The intake screenwash system supplies water for removing debris from the traveling screens at the Units 6&7 intake structure. The intake structure is equipped with three screenwash pumps. During normal operation, two screenwash pumps per intake structure are operated for 15 minutes once every 4 hours for a total of 90 minutes per 24 hours. Each intake structure's third screenwash pump is in "stand-by" mode, and is available for service if required. The rated design capacity of each screenwash pump is 1,800 gpm. During normal operation two screenwash pumps per intake operated for a total of 90 minutes per day.

CCPP's fire suppression system consists of three pumps that are always available for emergency situations. A main fire pump (2,000 gpm) and a diesel fire pump (2,000 gpm) are available for use when required. There are two jockey pumps (each 20 gpm) used to provide pressure to the fire suppression system. During normal operation, one jockey pump runs continuously 24 hours/day and the other jockey pump is in stand-by mode. Typically each pump is tested up to one hour per week to assure pump reliability and to occasionally flush the header system. Thus, normal operating flows assume about 4 hours/month per pump (0.133 hours/day).

2.5 Calculation Baseline

The calculation baseline is defined in the Phase II Rule as follows:

> *Calculation baseline means an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system has been designed as a once-through system; the opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody; and the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment. You may also choose to use the current level of impingement mortality and entrainment as the calculation baseline. The calculation baseline may be estimated using: historical impingement mortality and entrainment data from our facility or another facility with comparable design, operational, and environmental conditions; current biological data collected in the waterbody in the vicinity of your cooling water intake structure; or current impingement mortality and entrainment data collected at your facility. You may request that the calculation baseline be modified based on a location of the opening of the cooling water intake structure at a depth other than at or near the surface if you can demonstrate to the Director that the other depth would correspond to a higher baseline level of impingement mortality and/or entrainment.*

40 CFR § 125.93. This definition provides existing facilities with the ability to take credit for facility features that deviate from the calculation baseline and provide the benefit of fish

protection. If no credits are available, facilities can simply develop the baseline by documenting impingement mortality and entrainment using the “as built” approach.

The CCPP's intake structure conforms to the Phase II Rule’s calculation baseline assumptions based on the following:

- the cooling water system has been designed as a once-through system,
- the opening of the cooling water intake structure is located at the shoreline,
- the face of the standard 3/8-inch mesh traveling screen is oriented parallel to the shoreline, and
- the intake is located near the surface.

There are several significant deviations from these baseline assumptions at the CCPP: Units 1-5 were retired in part to reduce impingement and entrainment impacts; Unit 8 is designed to use a wet closed-cycle cooling system, and make-up water for the recirculating system is withdrawn from the Units 6&7 discharge; and both Units 6&7 had variable frequency pumps installed specifically to provide a fish protection benefit.

2.6 Applicable Performance Standards

As required for existing facilities under the Phase II Rule, CCPP will be required to reduce impingement by 80% to 95%. Because CCPP is located on an estuary as defined in the Phase II Rule, the facility is also subject to the entrainment performance standard. However, the Phase II Rule (§125.94(b)(2)(i)) clarifies that the entrainment standard does not apply if the capacity utilization rate is less than 15%. The Phase II Rule’s provides that the capacity utilization rate should be based on five years of data if available. Because Units 6&7 use a single intake structure, the capacity utilization rate is calculated as an average of the two units. Table 2-5 provides capacity utilization data for Units 6 and 7 starting in 2003. Mirant proposes to demonstrate compliance with this criterion by using the five-year period of 2003 through 2007 to support the conclusion that the capacity utilization rate is less than 15%, and therefore the entrainment performance standard is not applicable to the CCPP.

Table 2-5. Capacity utilization rate (%) for CCPP Units 6&7 from 2003 through 2005.

Year	Unit 6	Unit 7	Combined Average
2003	1.9	16.4	9.2
2004	4.1	21.7	12.9
2005	1.2	10.1	5.7
Average	2.4	16.1	9.3

3.0 COMPLIANCE ALTERNATIVES TO BE EVALUATED

This section of the PIC provides a description of specific alternatives and options that will be evaluated for compliance, and details Mirant's plans to collect and analyze the information that will be used to select a compliance alternative and complete the CDS. Mirant intends to evaluate the full range of compliance alternatives and options available in the Phase II Rule for potential use in the CDS.

As listed in Section 1.0, the Phase II Rule Compliance Alternatives are as follows:

1. A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality performance standard (the entrainment standard, as applicable still applies).

2. A facility can demonstrate that it already has a combination of technologies, operational measures, and restoration measures in place to meet the applicable performance standards.

3. A facility can propose to install a combination of new technologies, operational measures, and restoration measures to meet applicable performance standards.

4. A facility can propose to install, operate and maintain an approved design and construction technology.

5. A facility can request a site-specific determination of best technology available (BTA) by demonstrating that either the cost of installing technologies, operational measures, and restoration measures are either significantly greater than the cost for the facility listed in Appendix A of the rule or significantly greater than the benefits of complying with the applicable performance standards. 40 CFR § 125.94(a)(1-5).

The purpose of the CDS is to characterize impingement mortality and entrainment, to describe the operation of the facility's cooling water intake structure, and to confirm that the technologies, operational measures, and/or restoration measures selected and installed, or that will be installed, at the facility meet the applicable performance standards. 40 CFR § 125.95(b). The Phase II Rule requires the preparation and submittal of various elements depending on the compliance alternative selected. EPA recognized that this compliance alternative analysis is an iterative process, and decisions may be shaped by the results of the studies and data analysis that are conducted as part of the CDS. 69 Fed. Reg. at 41235.

Facilities adopting Compliance Alternative 1 are not required to submit a CDS. Compliance Alternative 1 provides that if facilities can demonstrate that they have reduced or will reduce flow commensurate with closed-cycle cooling, it is deemed to have met the performance standards for both entrainment and impingement. Further, Compliance Alternative 1 provides that if a facility can demonstrate that it has or will reduce its through-screen design intake flow to 0.5 feet/second or less, it will be deemed to have met the impingement mortality performance standard and need only complete those portions of the CDS relevant to demonstrating compliance with the entrainment performance standard.

Facilities implementing design and technology and/or operational measures pursuant to Compliance Alternatives 2 or 3 must complete a Design and Construction Technology Plan that includes descriptions of those measures that will be implemented to reduce impingement mortality and/or entrainment, and quantifications of those reductions. 40 CFR 125.95(b)(4)(i). Additionally, facilities implementing design and construction technologies and/or operational measures under Compliance Alternatives 2, 3, 4, or 5 must complete a Technology Installation and Operation Plan detailing an installation plan and plans to monitor the efficacy of the implemented measures, as well as a Verification Monitoring Plan that describes a two-year verification monitoring program. 40 CFR §§ 125.95(b)(4)(ii),(b)(7).

Facilities implementing restoration measures under any of the compliance alternatives must prepare a Restoration Plan demonstrating that design construction technologies and/or operational measures have been evaluated and have been determined to be less feasible, cost-effective and environmentally desirable than restoration measures. The Restoration Plan must also include a description of the proposed restoration measures and a quantification of their benefits, as well as monitoring plans. 40 CFR 125.95(b)(5).

Finally, facilities implementing site-specific measures under Compliance Alternative 5 must complete a Comprehensive Cost Evaluation Study and a Benefits Valuation Study if the cost benefit test is used, as well as a Site-Specific Technology Plan. 40 CFR 125.95(b)(6).

While Mirant has not yet selected a compliance alternative and will not be able to do so until it has completed the CDS information collection and analysis, this PIC describes plans to collect information that will inform all of the potentially required CDS elements and support the compliance alternative that is ultimately selected.

3.1 Use of Compliance Alternative 2 for Existing Fish Protection Design and Operational Measures

Mirant is planning to use somewhat difference compliance approaches for addressing the entrainment and impingement mortality reduction standards relative to Compliance Alternative 2 and therefore they will be discussed separately.

3.1.1 Entrainment

The Phase II Rule allows for use of a credit toward compliance under the calculation baseline for operational, design, or restoration measures that reduce entrainment and impingement. Mirant believes that CCPP has met the entrainment mortality reduction through the retirement of CCPP Units 1-5 and use of closed-cycle cooling for Unit 8.[8] The retirement of Units 1-5 and planned use of closed-cycle for Unit 8 have reduced entrainment by an estimated 68.5%. Since the reduction in cooling water is proportional to the reduction in entrainment, the entrainment reduction standard is met and no entrainment studies are proposed.

It is anticipated that the facility's Units 6&7 will operate at a combined capacity utilization rate less than EPA's criteria of 15% (See Table 2-5). However, Mirant also recognizes the need to meet California's electric demand, and consequently there is a possibility that capacity utilization in 2006 and/or 2007 could increase to a level that would subject the CCPP to the entrainment reduction performance standard. In such an event, Mirant plans to demonstrate that it already has a combination of technologies and operational measures in place to meet the applicable entrainment reduction standard of 60 to 90%. Because the capacity utilization rate is anticipated to be below 15% for the relevant 5-year period preceding the submittal of the Phase II studies, the entrainment standard will not be applicable to the CCPP.

As discussed in Section 2.6 above, recent capacity utilization data indicate that the entrainment performance standard does not apply to CCPP. In addition, based on operational forecasts, no significant changes are expected that would increase the combined Units 6&7 capacity utilization rate to 15% or greater. Thus, Mirant is not planning to conduct entrainment monitoring studies.

Mirant recognizes there is a small risk that generation demands may increase prior to submitting the CDS in January 2008 and that Mirant may exceed the 15% criteria. In this event, Mirant would prepare and submit the necessary documents in the CDS to demonstrate compliance with the entrainment reduction performance standard using Compliance Alternative 2. In the following section Mirant provides a discussion of the flow reduction measures it has already implemented to meet the entrainment performance standard.

[8] Although Unit 8 has not yet been completed, it is subject to the Phase II Rule because construction commenced in 2001 and therefore it is considered part of the existing facility. *See* 69 Fed. Reg. at 41578.

Mirant also recognizes that future NPDES permit cycles would require an ongoing demonstration that the entrainment reduction performance standard is met. If the 15% capacity utilization capacity is exceeded in the future and the flow reduction measures implemented under Compliance Alternative 2 were deemed not sufficient, Mirant would consider making “a binding commitment” [i.e., a permit restriction] to maintain capacity utilization below 15% for the life of the permit, in which case the rate may be based on this commitment.

3.1.1.1 Measures Under Compliance Alternative No. 2

Mirant plans to demonstrate that it has already reduced entrainment sufficiently to meet the entrainment reduction performance standard under Compliance Alternative 2. Compliance Alternative 2 allows “*the discharger to demonstrate that the existing design and construction technologies, operational measures, and/or restoration measures meet the performance specified in Section 125.94(b) of the rule and/or the restoration requirements specified in section 125.94(c) of the rule*.” For CCPP, compliance with the entrainment reduction standard has been achieved by a combination of actions to reduce flows that include: 1) retirement of CCPP Units 1-5; 2) use of a closed-cycle recirculating cooling water system for Unit 8; 3) installation and year-round operation of VFDs on both Unit 6 and Unit 7; and 4) reduced pump operation of Unit 6 and Unit 7 through proposed annual flow caps.

The Phase II Rule’s definition of the calculation baseline specifically allows facilities to take credit for cooling water flow reductions since these are recognized to be one of the most effective means to reduce both impingement mortality and entrainment.[9] It is therefore reasonable to assume that the flow reductions implemented or proposed for CCPP will achieve a proportional reduction in entrainment.

[9] EPA states in the Phase II Rule: “EPA believes the record contains ample evidence to support the proposition that entrainment is related to flow” (69 Fed. Reg. at 41612) and “absent entrainment control technologies, entrainment at a particular site is generally proportional to intake flow at that site.” (69 Fed. Reg. at 41599).

The specific actions taken to reduce flow at CCPP are as follows:

- Retirement of Units 1-5 – As shown in Table 2-1, the design cooling water flow for Units 1-5 was 547 MGD. The retirement of Units 1-5 represents a 55.4% reduction in total cooling water flow ((547+440)/987)). The decision to retire the units was prompted by the cost of upgrading these units to meet more stringent environmental rules, including air quality and water quality requirements. It was recognized that retiring the units would also reduce losses due to entrainment and impingement. This was evidenced in the Fact Sheet of the current Order No. 5-01-107 at page 10: "The removal of Units 1-3 from service reduces the volume of water diverted from the San Joaquin River, likely reducing entrainment and impingement impacts".

- Use of Closed-Cycle Cooling for Unit 8 – Use of closed cycle cooling for Unit 8 represents an additional 12.9% reduction in total cooling water flows from design flow assumptions. The Phase II Rule states in §125.95(b)(4)(C) that "Facilities that recirculated a portion of their flow, but do not reduce flow sufficiently to satisfy the compliance option in §125.94(a)(1)(i) may take into account the reduction in impingement mortality and entrainment associated with the reduction in flow when determining the net reduction associated with existing design and construction technologies and/or operational measures." There are many facilities around the U.S. that have one or more units that recirculate flow using a closed-cycle cooling system like Unit 8. The standard approach that is being used in PICs to estimate the reduction in entrainment for the recirculating unit(s) is to make the reasonable assumption of proportionality between flow and megawatt generation. As shown on Table 2-1, Units 1-7 total 1,271 gMW and have a design flow of 987 MGD. Assuming flow is proportional to gMWs, Unit 8 would have required 410 MGD (rounded) of cooling water flow ((530*987)/1,271).

Based on the total cooling water flow 987 MGD for Units 1-7 and the flow assumption of 410 MGD for Unit 8 had it been designed with once-through cooling, the total facility cooling water flow needed would have been 1,397 MGD. By retiring Units 1-5 and avoiding the 410 MGD of flow that would have been required for Unit 8, a total flow reduction of 957 MGD has been achieved. This represents a total flow reduction of 68.5% (957/1,397). Based on the Phase II Rule's assumption of proportionality between flow and entrainment these reductions have reduced flow to within the entrainment performance standard range of 60% to 90%.

In addition, further reductions have been achieved through the use of VFD technology and annual flow caps.

- Installation of VFD controls on circulating pumps for Units 6&7 – In 2004, the older technology VSD controls (variable speed drives) were replaced with the newer technology VFD controls (variable frequency drives), specifically for the purpose of improving the reliability of the controls to provide fish protection.[10] These pumps allow CCPP to reduce flow while also meeting electric power generation requirements for the region.

- Annual Flow Caps – Mirant has proposed to further reduce entrainment and impingement mortality through an annual cooling water flow cap of 121,000 MG as described in the Biological Assessment prepared for U.S Army Corps of Engineers in August 23, 2004.[11]

The Phase II Rule's calculation baseline allows the benefits of fish protection measures to be estimated using a variety of methods that include use of use of historical impingement mortality or entrainment data from CCPP or another facility with a comparable design, operation and environmental conditions, use of source waterbody biological data or collection of new data. In contrast to flow reduction achieved through the retirement of Units 1-5 and use of closed-cycle cooling for Unit 8 which provide a continuous reduction, the benefit of the reduction achieved by the VFD controls and flow caps is dependent on when flows are reduced relative to densities of entrainable life stages in the source waterbody.

The Phase II Rule allows demonstration that existing restoration measures may contribute to meeting the performance standard. *See* 69 Fed. Reg. at 41602. Mirant intends to take credit for two existing restoration programs that have been in place to compensate for entrainment losses. Mirant provides mitigation dollars to CDFG for losses of entrained striped bass based on an agreed upon loss reduction calculation. Mirant also provides annual compensation based on the amount of water withdrawn by CCPP and the current year delta smelt index.

3.1.2 Impingement

With respect to impingement mortality, the Phase II Rule: "EPA agrees that reducing intake by installing flow reduction technologies will result in a similarly high reduction of impinged and entrained organisms."

[10] See Letter from Catrina Martin, U.S. Fish and Wildlife Service, to Calvin Fong, U.S. Army Corps of Engineers, September 29, 2004.

[11] See footnote 2.

Based on EPA's statements in the Phase II Rule's preamble, a flow reduction warrants a baseline credit that is very comparable to the amount of the flow reduction. However, EPA also indicates that some consideration of velocity and fish swim speeds is warranted.[12] It is important to note that for CCPP Units 1-5, since the maximum through-screen design velocity of these units was 2.6 fps compared to 1.5 fps for Units 6&7, retirement of these units resulted in a greater benefit for impingeable fishes and shellfish to the extent that velocity is a factor for species found at CCPP. Similarly one of the benefits of the VFD controls on circulating water pumps is that when flows are reduced there is also a reduction in the through-screen velocity. Consistent with the Phase II Rule, Mirant intends to estimate a reduction in impingement mortality due to the flow reductions achieved through retirement of Units 1-5 and use of closed-cycle cooling for Unit 8. Fish swim speeds and velocity will be considered in estimating credit towards meeting the performance standard. The benefit of the flow reduction achieved through use of the VFD controls and annual flow caps is dependent on the amount of flow reduction and the level of impingement mortality that is occurring during periods of the flow reduction. Therefore, estimates of the impingement mortality reduction credit will be dependent on the results of the proposed one-year impingement study described in Section 4.0 and Appendix B.

3.2 Use of Technologies or Operational Measures under Compliance Alternatives 1, 3, 4, and 5

This section includes a review and evaluation of alternative cooling water system technologies that could potentially be implemented to achieve compliance with the Phase II Rule impingement mortality reduction standard, if necessary. Mirant is considering all of the alternative technologies and operational measures discussed in the Phase II Rule. *See* 40 CFR 125.95(b)(4). Our analysis of alternatives focuses on those technologies that are director-approved or may otherwise cost-effectively reduce impingement mortality.

Under any compliance alternative, fish protection technologies and/or operational measures must be evaluated. There are currently four major categories of fish protection technologies/operational measures: (1) exclusion systems (e.g., physical barriers); (2) fish collection and return systems; (3) diversion systems; and (4) behavioral systems (e.g., use of lights or sound). Table 3-1 provides a list of the specific technologies and operational measures to be evaluated for CCPP. Table 3-1 does not include a number of fish protection alternatives mentioned in the Phase II Rule since they were considered to be less likely to be cost effective or meet the applicable performance standards than other potential options. These less effective technologies and the reasons for not including them in the PIC at this time are as follows:

[12] See 69 Fed. Reg. at 41612 ("impingement is related to a combination of flow, intake velocity and fish swim speed").

- Closed-Cycle Cooling – Mirant does not plan to evaluate use of closed-cycle cooling for CCPP since flows have already been reduced sufficiently to meet the entrainment performance standard and provide a significant credit, if not meet, the impingement mortality reduction standard. Since significantly less costly compliance alternatives, including Compliance Alternative 1 options, are available for impingement closed-cycle cooling will not be considered.

- Reduced Cooling Water Pump Operation – It is not necessary to evaluate this alternative since Mirant has already installed VFD pumps to minimize flow to the extent possible and meet regional load demand.

- Certain Entrainment Reduction Technologies – The Phase II Rule mentions certain entrainment reduction technologies for which there are significantly lower cost impingement reduction alternatives. These include use of a barrier net instead of an aquatic filter barrier (AFB), use of wide slot (9.5 mm) wedgewire screens rather than narrow slot (0.5 mm), and use of coarse mesh (9.5 mm) rather than fine mesh (0.5 mm) Ristroph screens. Since the impingement reduction versions are significantly less costly and Mirant has already met the entrainment standard through flow reductions only the impingement mortality versions will be evaluated.

Table 3.1 lists the impingement reduction technologies and operational measures to be evaluated for CCPP.

Table 3-1. Technologies and operational measures planned for evaluation at the CCPP.

Technology/Operational Measure	Impingement Mortality Reduction
Wide-slot (9.5 mm) Wedgewire Screens	X
Wide-mesh Ristroph Traveling Screens	X
Barrier Net	X
Diversion Systems	X
Continuous or More Frequent Screen Rotation	X
Behavioral Devices	X

Each of the technologies that are proposed for evaluation in Table 3-1 is discussed below. For each technology the method of protection, the potential to meet the applicable standards, and issues and concerns are discussed.

3.2.1 Wide-Slot Cylindrical Wedgewire Screens

This technology is designed to reduce impingement mortality by reducing velocity. A schematic of the technology is shown in Figure 3-1. The deployment design depicted in Figure 3-1 shows the screen modules installed offshore. Another option is to mount the modules on a bulkhead along the shoreline. Wedgewire screens are typically designed to achieve a maximum through-slot velocity that does not exceed 0.5 fps. This would allow CCPP to achieve compliance under Compliance Alternative 1.

One concern relative to use of this technology is biofouling. The system is designed to handle fouling on the screen face through release of compressed air to blast fouling organisms and debris off the screens. However, this system will not prevent buildup of fouling organisms inside the pipes.

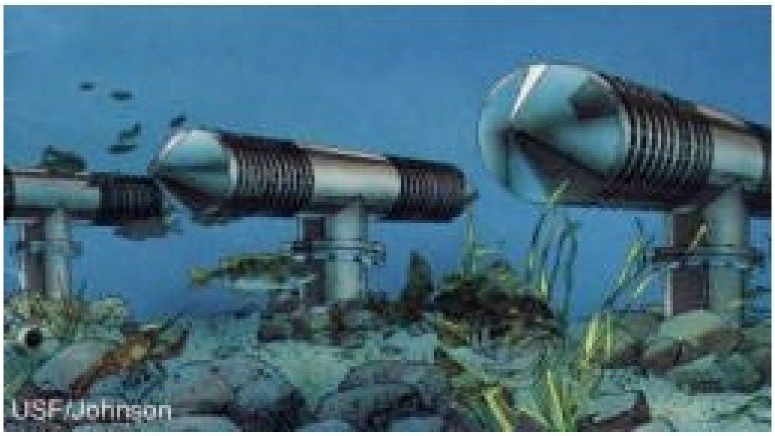

Figure 3-1. Example of wide-slot wedgewire screens.

3.2.2 Coarse-Mesh Vertical Traveling Screens with Improved Fish Return System

This technology is based on collecting impinged fish in buckets placed at the bottom of the screen panels and transferring them to a return system for transport to the source waterbody in a location designed to minimize risk of their return to the cooling water intake structure. An example of a coarse-mesh traveling screen is shown in Figure 3-2. Coarse mesh traveling screens have been installed at some large steam electric cooling water intakes. The cooling water approach velocity is an important factor that can affect performance. Normally these systems are designed to have an approach velocity that does not exceed 0.5 fps.

This alternative considers replacing the existing vertical traveling screens with new 5/32-in. traveling screens. Currently, as discussed in Section 2.0, the through-screen velocity of CCPP's Units 6&7 traveling screens exceeds the recommended 0.5 fps approach velocity and therefore, pilot studies may be required to document adequate survival rates in order to determine if additional screens would need to be installed to meet the performance standard. This determination would be important in evaluating this option since the addition of more screens would significantly decrease this option's cost-effectiveness.

The screen design would also include a primary low-pressure spray system designed to gently rinse the fishes and shellfish from the screens into the fish return system for transport to the Estuary. The system would be designed to operate continuously to return impinged organisms to the Estuary quickly and in good condition. The improved spray wash system would increase the efficiency of the overall removal of debris from the screen surface and intake well, reducing the potential for organism entanglement, and maintaining low screen approach velocities. Reductions in the amount of debris immediately in front of the intake would lower the potential for entanglement and impingement of organisms such as fishes, shrimps, and crabs. Finally, consideration must be given as to where to return the impinged organisms. Currently impinged organisms are returned to the discharge tunnel near Outfall 002. It is important to recognize that species vary greatly in their ability to tolerate the fish collection, handling and transport associated with this technology even at low intake velocities. It would therefore be important to evaluate survival of abundant species prior to installation of this option.

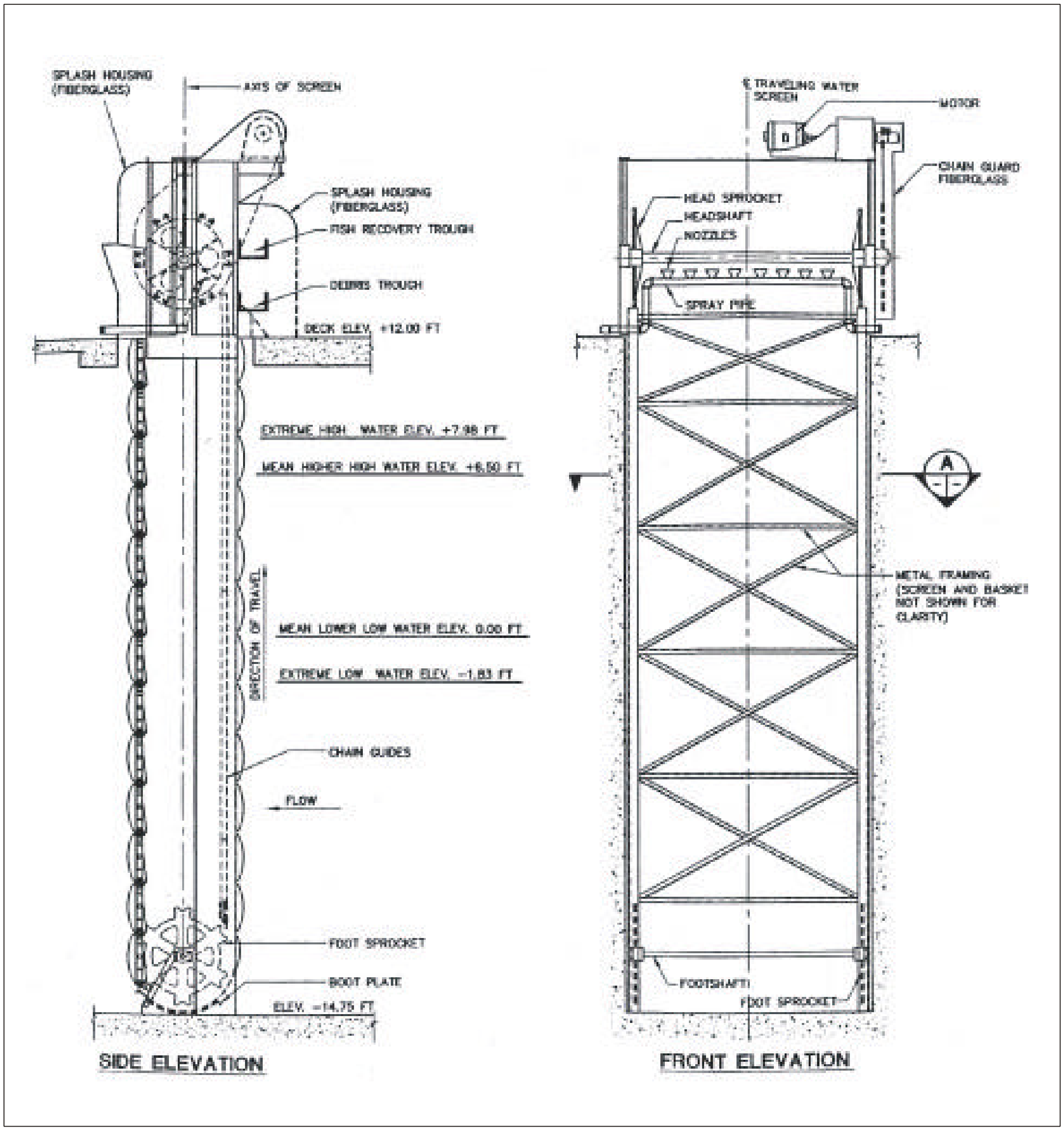

Figure 3-2. Example of coarse-mesh vertical traveling screen system.

3.2.3 Barrier Nets

This technology functions by expanding the surface area of the intake and thereby reducing the through-screen (i.e., net) velocity. All cooling water flow to the intake passes through the net, so all impingeable fish and shellfish are blocked from entering the intake. The barrier net can be sized large enough to achieve through-net velocities of 0.5 fps or less, and thus qualify for use under Compliance Alternative 1 for the impingement mortality performance standard. Since the mesh size is designed to provide protection for impingeable fishes and shellfish, a mesh size at CCPP equivalent to the 3/8-in. mesh traveling screen panels would be required. The design and location of barrier nets are site-specific and take into consideration the characteristics of local fish populations and concentrations of debris. Barrier nets have been effective in reducing impingement rates at a number of power plants. Barrier nets can be deployed seasonally to protect fishes and therefore could be used under Compliance Alternative 3 on a seasonal basis depending on the results of the proposed Impingement Mortality Study.

Given the proper hydraulic conditions (primarily low velocity) and when located in areas without heavy debris loading, barrier nets have been effective in preventing fishes from entering water intake canals. Several barrier nets located in the Midwestern U.S. have been studied.[13] At the Ludington Pumped Storage Plant on Lake Michigan, a 2.5-mile-long barrier net set around the intake jetties successfully reduced the impingement of all the fish species found in the vicinity of the intake.[14] The net was first deployed in 1989, and the original design was modified to be 96% effective for four species (yellow perch, rainbow smelt, alewife, and chub).

The Chalk Point Station on the Patuxent River used a two-barrier net system located at the mouth of its intake canal.[15] The outermost net (1.25-in. stretch mesh) trapped most of the debris and jellyfish, while a finer mesh (0.75-in. stretch mesh) inner net prevented impingement of smaller marine organisms (Figure 3-3). Modifications of the original system increased its effectiveness and achieved an 84% reduction in impingement of crabs.

While this technology can be a lower cost option for reducing impingement, several potential concerns must be considered: (1) how frequently nets would need to be changed to control fouling and debris loading; (2) the risk that the barrier could become an obstruction to navigation given its offshore deployment; and (3) the necessity to withstand storms that may be affect barrier net feasibility at CCPP.

[13] Michaud, D. T. and E. P. Taft. 1999. Recent Evaluation of Physical and Behavioral Barriers for Reducing Fish Entrainment at Hydroelectric Projects in the Upper Midwest. Proceeding of the EPRI/DOE Power Generation Impacts on Aquatic Resources Conference, Atlanta, GA (April 1999).

[14] Reider, R. H., D. D. Johnson, P. B. Latvaitis, J. A. Gulvas, and E. R. Guilfoos. 1997. Operation and Maintenance of the Ludington Pumped Storage Project Barrier Net. *In:* Fish Passage Workshop, Milwaukee, WI, May 6-8, 1997.

[15] Loos, J. L. 1986. Evaluation of Benefits to PEPCO of Improvements in the Barrier Net and Intake Screens at Chalk Point Station Between 1984 and 1985. Prepared for Environmental Affairs Group Water and Land Use Department Potomac Electric Power Company Washington, D. C.

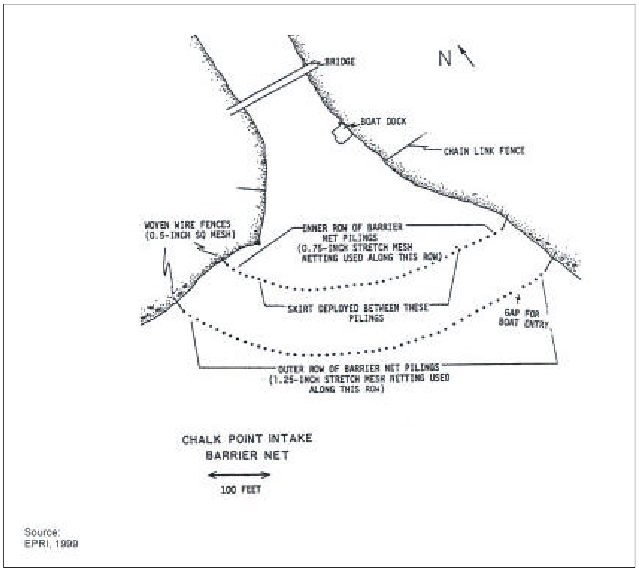

Figure 3-3. Chalk Point barrier net configuration.

3.2.4 Fish Diversion and Conveyance Systems

Fish diversion and conveyance systems protect impingeable fishes and shellfish by guiding them to a location where they can be collected and transported away from the traveling screens. Thus, fish diversion systems such as louvers and angled screens are effective only when they are installed and operated in concert with an effective fish return conveyance system. Generally, fishes are diverted to a location where a conveyance system such as a fish pump can be used to transport them to a safe location in the source waterbody. A louver diversion system consists of an array of evenly spaced, vertical slats (similar to a venetian blind) aligned across an entry channel at a specified angle leading to a fish bypass. The design of the diversion system is based on the approach flow velocity and swimming speed of fishes. The system is designed to create a stimulus in the water to divert fish to a safer area. The effectiveness of the system is based on species characteristics, life stage, and site specifics. Louvers generally are not considered acceptable by most environmental regulatory agencies in the country because they have been less effective compared to other fish protection systems. However, the louver system has been deployed in riverine environments with migratory species. Since louver arrays are necessarily set at an angle to the flow, they require a length of an intake channel or canal to work effectively. They are not practicable at shoreline intake locations, but have been used at onshore intake screen wells used in conjunction with offshore-submerged intakes that are known to entrap fishes.

The angled screen design is composed of a series of vertical traveling screens arranged strategically at a certain angle to maximize fish/marine animal diversion leading to a primary bypass line. The organisms captured in the primary bypass line will typically be led to a secondary bypass line, holding tank, or released back to the natural habitat. Most of these screen installations or applications have been designed to protect young salmonids. Angled screens have been studied for possible use at cooling water intake structures to protect a variety of fishes in freshwater, riverine, estuarine, and marine environments. They also have been used in hydroelectric and irrigation intake facilities. The results of those experiences have indicated that the angled screen system can be very effective in diverting fishes to the bypass line given the proper physical and hydraulic conditions. Generally these systems have not been employed at existing power plants; however, generic pilot studies and deployment in smaller systems such as agricultural diversions have indicated promising results. Assessment of these systems at CCPP would be driven by a preliminary evaluation of cost in comparison to the other technologies designed to reduce only impingement mortality to determine if a more detailed evaluation is warranted.

3.2.5 Continuous or More Frequent Screen Rotation with Fish Return System

This fish protection technology is based on the same principle as coarse mesh Ristroph previously discussed in Section 3.2.2 above. If many of the impinged fishes are observed to be alive during the Impingement Mortality Study, simply rotating screens on a more frequent or continuous basis could be sufficient to meet the Impingement Mortality reduction standard. If reasonable survival is noted, Mirant may propose studies to hold fish in order to demonstrate latent survival and that the impinged fish are not moribund.

It is important to note that the current use of the screen refuse pump would need to be evaluated to avoid mortality from the system. It is also important to note that conventional screens are generally not designed for continuous rotation. Thus, upgrading of the traveling screens with more durable hardware may be necessary depending on the increase in screen rotation that would be required to meet the standard (i.e., after taking credit for flow reduction). Also as with coarse mesh Ristroph a return location will have to be identified to minimize the risk of re-impingement.

3.2.6 Behavioral Devices

Behavioral systems use a “scarecrow” approach for fish protection. They include approaches such as use of strobe lights or sounds to keep fish and shellfish away from the cooling water intake structure. Currently available information on these systems indicates that they elicit a response from only certain species and that in some cases species adapt to these devices such that effectiveness declines over time. However, this tends to be a relatively low cost option and

Mirant is planning to monitor new tests on use of these systems being conducted by EPRI in the southeast at two Phase II facilities located on freshwater reservoirs. Should these tests indicate improvements in the performance of this technology Mirant might consider further site-specific evaluation of this technology.

3.2.7 Use of Pilot Studies, Compliance Alternative 4, and Additional Technologies

As noted in the discussion for most of the technologies and operational measures to be evaluated, there are significant uncertainties related to feasibility, effectiveness, and cost that may require pilot studies. Due to the cost of conducting pilot studies, Mirant will consider such studies after a preliminary evaluation of the feasibility, cost and effectiveness of alternatives is completed.

Compliance Alternative 4 provides that facilities may comply with the performance standards by implementing approved technologies. Currently, the only named EPA pre-approved technology is wedgewire screens in rivers that meet certain criteria. However, the Phase II Rule provides a process that allows additional technologies to become listed as pre-approved technologies. *See* 40 CFR § 125.99(b). New technologies can be so designated by providing information to demonstrate that, if installed in the proper waterbody type, the technology could meet the performance standard for which they are pre-approved. Currently, Mirant is not aware of additional technologies to recommend to the Water Board for consideration for designation as qualifying for Compliance Alternative 4. However, the Phase II Rule has generated a good deal of interest in developing new fish protection technologies. Mirant plans to monitor the development and testing of new technologies for potential use. If a qualifying technology is identified, Mirant may recommend to the Water Board that such new technology be considered for designation. Similarly, Mirant plans to monitor development of new impingement reduction technologies for use under Compliance Alternatives 1, 3, or 5 and modify the PIC to include such technologies if appropriate.

3.3 Use of Restoration under Compliance Alternatives 3 and 5

The Phase II Rule provides that applicants may use restoration measures in addition to, or in lieu of, technology measures to meet performance standards or as a best technology available (BTA) component on a site-specific basis. The basic philosophy of restoration is to mitigate fish and shellfish losses at a cooling water intake structure by either direct supplementation (stocking) of a “species of concern” potentially impacted by the cooling water intake structure, or provision, protection, and restoration of habitat that “produces” fishes and shellfish and thereby replaces those lost due to impingement mortality and entrainment. As part of the requirement for use of restoration, Mirant plans to fully evaluate available technologies and/or operational measures to determine whether existing and supplemental restoration is more feasible, cost-effective, or environmentally desirable than meeting the impingement mortality performance standard through the use of technologies and/or operational measures alone (see below in Section 3.4).

Appendix A of the PIC provides a summary of the kinds of restoration measures that will be considered. Although the list is not exhaustive, the restoration project examples are listed for the following reasons: (1) their 316(b) application history by other power companies, (2) known interest in the local area based on an internet review of state programs, and (3) because design and implementation information is readily available. The basic categories of considered projects are as follows:

- habitat protection or creation program,
- fish stocking,
- waterbody restoration, and
- removal of obstruction to migratory fish on tributaries.

Other types of projects may be identified in discussions with appropriate state and federal agencies.

Mirant plans to discuss these ideas and consider other restoration alternatives that may be applicable, and will also consider working with other entities to develop joint restoration projects. The analysis of impingement mortality data will be used in determining the amount of restoration necessary to provide a minimum benefit equivalent to at least an 80% impingement mortality reduction as required by the Phase II Rule after credit is considered for impingement mortality flow reduction.

3.4 Use of Site-Specific Standards under Compliance Alternative 5

Mirant plans to evaluate potential use of both the Cost-Cost and Cost-Benefit tests under Compliance Alternative 5. Use of these cost tests are provided to allow Phase II facilities to avoid costs that would be considered significantly greater than either the costs estimated by EPA for those facilities or the economic value of the site-specific environmental benefits that would be achieved. If the evaluation of the current impingement reduction technologies and operational measures indicates that the impingement mortality performance standard is not met, or that the use of restoration measures for offsetting impingement losses is not available, these tests will be used in conjunction with the evaluation of technologies and operational measures discussed in Section 3.1 of the PIC.

3.4.1 Evaluation of Cost-Cost Test

In developing the national cost of implementing the Phase II Rule, EPA considered the cost for each Phase II facility to comply. If the actual cost estimated for a facility to meet the performance standard, based on a site specific analysis, is determined to be significantly greater than the cost estimated by EPA for the facility to comply, the facility can apply for a site-specific demonstration under the cost-cost test using Compliance Alternative 5. The site-specific standard would be that achieved by the use of the best performing technology (i.e., achieve the highest level of protection) or operational measure that would pass the cost-cost test. CCPP is identified as facility number AUT0621 in Appendix B of the Phase II Rule. EPA in Appendix A indicated that CCPP was only subject to impingement performance standard. The modeled impingement mortality technology used by EPA was the addition of a fish handling and return system (to be evaluated as discussed in Section 3.2) at an estimated annualized cost of $462,340. This is the appropriate number that Mirant plans to evaluate for use in evaluating technologies under Cost-Cost Test. However, in the event that there is an increase in capacity utilization in the future such that the entrainment performance standard is applicable to CCPP and it were determined that flow had not been sufficiently reduced to comply the Appendix A value would need to be adjusted for entrainment. The Rule's preamble specifies an adjustment factor of 2.148 to convert the Appendix A cost for impingement mortality reduction to a cost for both impingement mortality and entrainment reduction. Using this conversion factor the adjusted Appendix A cost for entrainment is $993,106.32. This would be the cost that Mirant would use to evaluate the Cost-Cost for entrainment should the need to do so arise in the future.

3.4.2 Evaluation of Cost-Benefit Test

The economic value of the environmental benefit of meeting the performance standards will also be evaluated. This evaluation will include the cost of any impingement mortality reduction technologies. This analysis would include consideration of information to be collected by Mirant as part of the CDS. A detailed discussion of the approach that Mirant proposes to use for the Cost-Benefit Test under the Benefits Valuation Study is provided in Appendix C of the PIC.

4.0 BIOLOGICAL STUDIES

The Phase II Rule requires that a summary of historical entrainment and impingement mortality studies and/or physical and biological studies conducted in the vicinity of the cooling water intake structure be provided as well as study plans for any new studies to be conducted. Several biological studies of CCPP's cooling water intake systems were conducted by CCPP's former owner, Pacific Gas and Electric Company (PG&E). Although Mirant recognizes that the historical entrainment data are not representative of current conditions, summaries of these studies are provided below in Sections 4.1–4.3.

The first study, conducted during the early 1950s, examined ways to reduce fish impingement. In response to the requirements of Section 316(b) of the Clean Water Act, PG&E, conducted an intensive study in 1978–1979 (PG&E 1981) of the entrainment and impingement of fishes and invertebrates resulting from the operation of the CCPP cooling water system. Although the conclusion of these studies was that no alternative intake technologies or changes to the operations of CCPP were required to reduce impacts to entrained or impinged fish species, the Water Board required that PG&E install and operate Variable Speed Pumps during the time that young striped bass are susceptible to entrainment at CCPP. The Striped Bass Density Monitoring Program was developed to determine the presence and abundance of striped bass at both CCPP and the nearby Pittsburg Power Plant. The 316(b) studies and the Striped Bass Density Monitoring Program were conducted to comply with NPDES permit provisions issued by the Water Board and were conducted cooperatively with CDFG, U.S. Fish and Wildlife Services and NOAA Fisheries.

4.1 1950s Units 1-5 Fish Impingement Study

The first investigations were performed at the CCPP Units 1-5 intake during the early 1950s (Kerr 1953). The objective of these early studies was to modify the Units 1-5 intake system to minimize the numbers of fishes impinged. As a result of these early investigations, an effective fish pump removal system designed to remove fishes from the area in front of the screens was installed at the Units 1-5 intake. The fish pump was effective in substantially reducing the numbers of fishes impinged while maintaining high survival rates for those fishes removed from the intake and returned to the water body (Kerr 1953, PG&E 1981a). In addition, based on results of the early investigations, Kerr (1953) developed design criteria for cooling water intake structures to minimize and avoid fish impingement. The recommended design criteria (e.g., intake approach velocities, configuration of the intake structure including lateral fish escape routes and intake screens located parallel to the shoreline, and avoidance of recessed intake configurations where fishes may become entrapped) were used in the design of the CCPP Units 6&7 and Pittsburg Power Plant Units 1-7 cooling water intake structures and have been recognized nationally as the recommended design for power plant once-through cooling water systems (EPA 1977).

4.2 1978–1979 Cooling Water Intake Structures 316(b) Demonstration

In response to the requirements of Section 316(b) of the Clean Water Act, PG&E conducted an intensive study in 1978–1979 (PG&E 1981) of the entrainment and impingement of fishes and macroinvertebrates resulting from the operation of the CCPP cooling water system.

4.2.1 Entrainment

The objective of the CCPP entrainment abundance and survival studies was to estimate the number and taxa of organisms exposed to the plant's cooling water system. The entrainment abundance and survival (proportion of organisms not surviving passage through the system) studies focused on the early life stages of fishes (ichthyoplankton) and selected macroinvertebrates (the opossum shrimp *Neomysis mercedis* and the oriental shrimp *Palaemon macrodactylus*). The species composition, length (ichthyoplankton), and the seasonal and diel patterns of entrainment were also determined.

The numbers of ichthyoplankton and macroinvertebrates entrained were estimated by sampling a portion of the cooling water flow once or twice a week for 16 months (April 1978 through August 1979). Samples were collected at the Units 1-5 discharge from April 1978 to August 1979, and from Unit 7 discharge from April 1978 to April 1979. The densities collected at Unit 7 were found to be representative of densities collected from Unit 6.

Results

Fish Eggs

For the period between April 1978 and March 1979, an estimated 3.7 million fish eggs were entrained at Units 1-5, and 13 million entrained at Units 6&7. Ninety-five percent of the eggs from Units 1-5 and 69% from Units 6&7 could not be identified. Of those eggs that could be identified, striped bass, hitch, and smelts were the most abundant taxa. Fish eggs were entrained from January through August; the greatest densities of eggs occurred in May and June (up to 0.12/m³ at Units 1-5 and 0.4/m³ at Units 6&7).

Fish Larvae and Juveniles

An estimated 160 million fish and larvae (65 million at Units 1-5 and 95 million at Units 6&7) were entrained under actual flow conditions at CCPP between April 1978 and March 1979. The maximum densities were in May and June of 1978 (up to 1.6/m³ at Units 1-5 and up to 1.0/m³ at Units 6&7). The seasonal patterns of entrainment were similar for all units. Five taxa (striped bass *Morone saxatilis*, prickly sculpin *Cottus asper*, threadfin shad *Dorosoma petenense*, smelts Osmeridae, and yellowfin goby *Acanthogobius flavimanus*) made up 94% of the fishes entrained at Units 6&7 and 90% at Units 1-5.

Striped bass were the most abundantly entrained fish. An estimated 41 million were entrained at Units 1-5 and 39 million at Units 6&7. The prickly sculpin was the second most abundantly entrained larval and juvenile fish. Approximately 3.3 million prickly sculpin were entrained at Units 1-5 and 21 million at Units 6&7. Threadfin shad was the third most common entrained larvae and juvenile fish. There were approximately 2.7 million entrained at Units 1-5 and 15 million at Units 6&7. Smelt larvae and juveniles, including delta smelt and longfin smelt, were the fourth most commonly entrained. An estimated 10.3 million were entrained at Units 1-5 and 5.5 million at Units 6&7.

Fishes having potential economic value, but entrained in low numbers included Chinook salmon *Oncorhynchus tshawytscha* and American shad *Alosa sapidssima*. While no Chinook salmon were entrained at Units 1-5, an estimated 9,000 Chinook salmon were entrained at Units 6&7. At Units 1-5, an estimated 5,000 American shad were entrained and an estimated 70,000 were entrained at Units 6&7.

Macroinvertebrates

Of the two macroinvertebrates examined in entrainment samples from April 1978 to April 1979, the opossum shrimp *Neomysis mercedis* was the most abundant. An estimated total of 7 billion were entrained at Units 1-5 and Units 6&7 from April 1978 to March 1979. An estimated 92 million oriental shrimp *Palaemon macrodactylus* were entrained at Units 1-5 and Units 6&7 during the same time period. From May through August, biweekly samples from Units 1-5 and Units 6&7 were processed only for *Neomysis mercedis*.

Overall counts of the most commonly entrained fishes and the two macroinvertebrates are summarized in Table 4-1.

Table 4-1. Estimated numbers (millions) of ichthyoplankton and macroinvertebrates entrained at the CCPP under actual pump operation: April 1978 - April 1979.

Taxon		Units 1-5			Units 6&7		
Common Name	**Scientific Name**	**Number Entrained**	**Standard Error**	**Percentage Composition**	**Number Entrained**	**Standard Error**	**Percentage Composition**
Fish Larvae and Juveniles							
Striped bass	*Morone saxatilis*	41.28	5.23	63.43	39.44	4.12	41.47
Prickly sculpin	*Cottus asper*	3.34	—	5.13	21.46	—	22.56
Threadfin shad	*Dorosoma petenense*	2.69	0.38	4.13	14.97	2.53	15.74
Smelts*	Osmeridae	10.31	2.17	15.85	5.52	0.67	5.8
Delta smelt*	*Hypomesus transpacificus*	0.01	0.01	0.01	0.01	0.01	0.01
Yellowfin goby	*Acanthogobius flavimanus*	0.86	0.12	1.32	5.31	1.05	5.58
Starry flounder	*Platichthys stellatus*	0.25	0.07	0.39	0.38	0.1	0.40
White catfish	*Ictalurus catus*	0.11	0.04	0.17	0.33	0.1	0.37
Pacific herring	*Clupea pallasii*	0		0	0.17	0.11	0.18
Bigscale logperch	*Percina macrolepida*	*	*		0.29	0.14	0.3
Sunfishes	Centrarchidae	0.07	0.04	0.1	0.12	0.04	0.13
Unidentified gobies	Gobiidae	0.03	0.02	0.05	0.2	0.07	0.21
Others		6.13	—	9.42	6.91	—	7.27
Total		65.08		100	95.11		100
Fish Eggs							
Unidentified	Osteichthyes	2.59	1.06	69.81	12.22	4.29	95.47
Smelts	Osmeridae	0.91	0.31	24.53	0.28	0.09	2.19
Striped bass	*Morone saxatilis*	0.10	0.05	2.96	0.18	0.1	1.4
Hitch	*Lavina exilicauda*	0.11	0.09	2.96	0	0	0
Northern anchovy	*Engraulis mordax*	0		0	0.01	0.01	0.08
Catfishes	*Ictalurus* spp.	0		0	0.08	0.07	0.63
Sunfishes	Centrarchidae	0		0	0.05	0.02	0.23
Total		3.71		100	12.8		100
Macroinvertebrates							
Opossum shrimp	*Neomysis mercedis*	3,633.38	233.31		3,427.71	210.94	
Oriental shrimp	*Palaemon macrodactylus*	26.09	3.76		66.12	7.74	
Total		3,659.47			3,493.83		

(*) Indicates less than 10,000 individuals.

(—) Indicates combined standard errors were not calculated.

Source: PG&E 1981

*Note: The category "smelts" is comprised of both delta smelt and longfin smelt. During the time the entrainment studies were conducted, taxonomic keys had not yet be developed so that larval smelt could be distinguished from each other. The delta smelt listed on this table are likely post larval specimens.

4.2.2 Impingement

Two complementary studies were conducted at the CCPP to provide a quantitative assessment of the numbers of fishes and macroinvertebrates impinged and lost to the local population due to the operation of the CCPP cooling water system. The first study, impingement abundance, was designed to determine the species composition, lengths and weights, and sex ratio and maturity of the impinged organisms. Also of interest were diel and seasonal patterns of impingement, the probability of impingement at the bar racks, and the relationship between plant operation and impingement. The second study, impingement survival, was designed to provide species specific data that would allow for computation of proportional impingement survival rates. An additional study, fish pump efficiency, was conducted to determine the effectiveness of the installed Units 1-5 fish pump system in reducing impingement.

The objectives of the impingement abundance study were to:

- Determine the species composition of the organisms impinged,
- Determine the lengths and weights of impinged organisms,
- Determine the sex and gonadal maturity of selected organisms,
- Determine diel and seasonal patterns of impingement,
- Examine the relationship between plant operation parameters and impingement rates, and
- Assess the occurrence of impingement on the bar racks.

Impinged fishes and macroinvertebrates, and debris were washed off the vertical traveling screens and into screenwash sluiceways where the material ultimately was collected in sampling baskets at the lower end of the sluiceway.

Results

Impingement estimates of the most commonly impinged fishes and macroinvertebrates for the period April 1978 through April 1979 based on actual pump operation are provided in Table 4-2. Annual fish impingement estimates for 1978 at Units 1-5 were approximately 219,000 and 108,000 for Units 6&7 (Table 4-2). For 1979 (from May 1979 to January 1980) fish impingement estimates based on actual pump operation for Units 1-5 were 587,000 and for Units 6&7 were 86,000 (Table 4-3). Included in the Units 1-5 estimates for 1979 were extrapolated estimates of fish removed by fish pumps. This extrapolation was based on continuous fish pump operation.

The seven most abundantly impinged fish species accounted for approximately 94% of the fishes collected during April 1978–April 1979 (both intakes combined). These included: the striped bass *Morone saxatilis*, threadfin shad *Dorosoma petenense*, American shad *Alosa sapidissima*, yellowfin goby *Acanthogobius flavimanus*, longfin smelt *Spirinchus thaleichthys*, Sacramento splittail *Pogonichthys macrolepidotus*, and white catfish *Ictalurus catus*. The four fish species most commonly impinged, striped bass, threadfin shad, yellowfin goby, and American shad, constituted 85% of the estimated impinged fishes in the April 1978–April 1979 study and 96% in the May 1979–January 1980 study (both intakes combined).

Estimated annual impingement of macroinvertebrates was 179,000 for Units 1-5 and 141,000 for Units 6&7 during the April 1978–April 1979 study (Table 4-2). Estimates for the May 1979–January 1980 study were 297,000 for Units 1-5 and 209,000 for Units 6&7 (Table 4-3). The most frequently impinged macroinvertebrates during both the 1978 and 1979-1980 study were the oriental shrimp *Palaemon macrodactylus*, bay shrimp *Crangon franciscorum*, and the pebble crab *Rhithropanopeus harrisii*.

Table 4-2. Estimated numbers of selected fishes and macroinvertebrates impinged at the CCPP under actual pump operation: April 1978 - April 1979.

Taxon		**Units 1-5**			**Units 6&7**			**Total Units 1-7**			
Common Name	**Scientific Name**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Percent**	**Weight (kg)**	**Percent**
Fishes											
Striped bass	*Morone saxatilis*	93,059	13,567	1,101.8	43,090	5,721	314.7	136,149	41.6	1,416.5	39.7
Threadfin shad	*Dorosoma petenense*	66,129	5,936	525.6	41,099	11,509	173.9	107,228	32.8	699.5	19.6
American shad	*Alosa sapidissima*	17,265	2,995	115.8	2,337	408	27.1	19,602	6.0	142.9	4.0
Yellowfin goby	*Acanthogobius flavimanus*	12,025	2,894	184.1	2,805	325	26.4	14,830	4.5	210.5	5.9
Longfin smelt	*Spirinchus thaleichthys*	13,518	5,663	68.3	887	319	3.5	14,405	4.4	71.8	2.0
Sacramento splittail	*Pogonichthys macrolepidotus*	4,665	863	44.5	5,593	1,004	32.1	10,258	3.1	76.6	2.1
White catfish	*Ictalurus catus*	3,032	847	154.4	2,836	249	277.3	5,868	1.8	431.7	12.1
Other fish		9,776	979	131.9	8,974	577	388.4	18,750	5.7	520.3	14.6
Total		219,469		2,326.4	107,621		1,243.4	327,090		3,569.8	
Macroinvertebrates											
Pebble crab	*Rhithropanopeus harrisii*	128,003	12,934	204.8	87,070	4,664	106.5	215,073	67.2	311.3	68.1
Oriental shrimp	*Palaemon macrodactylus*	47,777	7,157	57.4	53,701	2,911	85.0	101,478	31.7	142.4	31.2
Bay shrimp	*Crangon franciscorum*	2,744	1,930	2.5	523	235	0.7	3,267	1.0	3.2	0.7
Other macroinvertebrates		12	8	–	54	20	–	66		–	
Total		178,536		264.7	141,348		192.2	319,884		456.9	

Source: PG&E 1981.

Note: There may be slight discrepancies in percentages that are due to rounding.

Table 4-3. Estimated numbers of selected fishes and macroinvertebrates impinged[(a)] at the CCPP under actual pump operation: May 1979–January 1980.

Taxon		Units 1-5			Units 6&7			Total Units 1-7			
Common Name	**Scientific Name**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Percent**	**Weight (kg)**	**Percent**
Fishes											
Striped bass	*Morone saxatilis*	470,066	27,686	4,129.2	51,229	9,741	375.6	521,295	77.5	4,504.8	61.2
Threadfin shad	*Dorosoma petenense*	55,755	6,444	401.9	21,231	2,433	103.1	76,986	11.4	505.0	6.9
Yellowfin goby	*Acanthogobius flavimanus*	23,631	1,973	445.6	2,543	390	40.7	26,174	3.9	486.3	6.6
American shad	*Alosa sapidissima*	19,123	1,772	118.9	790	287	7.2	19,913	3.0	126.1	1.7
Other fish		18,650	1,915	592.1	9,714	817	1,145.9	28,364	4.2	1,738.0	23.6
Total		587,225		5,687.7	85,507		1,672.5	672,732		7,360.2	
Macroinvertebrates											
Oriental shrimp	*Palaemon macrodactylus*	192,894	11,836	187.2	189,251	18,269	167.0	382,145	75.4	354.2	58.3
Pebble crab	*Rhithropanopeus harrisii*	100,391	10,130	212.8	1,193	498	32.9	101,584	20.1	245.7	40.4
Bay shrimp	*Crangon franciscorum*	3,931	1,613	3.8	18,806	1,111	1.0	22,737	4.5	4.8	0.8
Other macroinvertebrates		0			51	32	3.1	51	0	3.1	0.5
Total		297,216		403.8	209,301		204.0	506,517		607.8	

Source: PG&E 1981.

(a) Units 1-5 estimate includes estimated numbers returned to the Estuary by the fish pump return system.

Note: There may be slight discrepancies in percentages that are due to rounding.

4.3 1986–1992 Striped Bass Monitoring

As part of the program to reduce striped bass entrainment losses, Striped Bass Density Monitoring Program (SBDMP) was conducted at CCPP from 1986–1992. Each year, entrainment monitoring commenced May 1 and typically continued to mid-July.

The SBDMP was designed to provide information on the relative abundance and temporal distribution of larval and juvenile striped bass susceptible to entrainment at the CCPP between May 1 and July 15, or the date that CDFG predicted that the 38-mm striped bass index was to be set, whichever was earlier. This program consisted of two related monitoring programs: a Threshold Monitoring Program and an Entrainment Abundance Monitoring Program. The monitoring programs are described in NPDES Permit from the Water Board and the Agreement between the Pacific Gas and Electric Company and the California Department of Fish and Game for the Monitoring and Mitigation of Striped Bass in the Sacramento-San Joaquin Estuary (PG&E 1995). The monitoring was conducted annually unless waived by mutual consent of PG&E/Mirant and CDFG. Specific details of the sampling program are discussed below.

Samples of entrained organisms were collected by filtering water pumped from the Units 6&7 discharge gate well with a 4-in. diameter recessed-impeller pump. Entrainment samples were collected from either Unit 6 or Unit 7 with 4-in. PVC sampling pipes.

Each entrainment sample was sorted using an illuminated magnifier to remove fish larvae and eggs. Striped bass eggs and larvae were identified, counted, and the total lengths of larvae were measured to the nearest millimeter. All other fishes were identified to species when possible. Following identification and measurement, fish eggs and larvae were placed in labeled vials and archived. Archived samples were generally discarded after one year, with CDFG consultation and approval.

Concentrations of striped bass were calculated from the entrainment samples; no data analysis was conducted for other species as part of the Striped Bass Monitoring Program. The striped bass concentrations were used to estimate entrainment based on actual cooling flows during the time monitoring was conducted.

Impingement Investigations from 1987 through 1990

Impingement monitoring was performed at cooling water intakes for both power plants over three years from 1987 through 1990. In general, the impingement sampling was done once a month from August through February. Unlike entrainment monitoring where a relatively small volume of cooling water is sampled, impingement samples were collected under actual cooling water flow withdrawals.

4.4 Establishing the Impingement Mortality and Entrainment Characterization Baseline

Impingement mortality and entrainment characterization study data “may include historical data that are representative of the current operation of your facility and the biological conditions at the site.” 40 CFR § 125.95(b)(3)(ii). “If the facility proposes to use existing data, it must demonstrate that the data are representative of current conditions and were collected using appropriate quality assurance/quality control procedures.” Mirant recognizes that the historical entrainment data are not representative of current conditions. However, since the Phase II Rule assumes a proportional relationship between flow and entrainment, and CCPP has reduced flow sufficiently to be in the 60% to 90% performance standard range, no entrainment studies are proposed. Because the relationship between flow reduction and impingement reduction is not proportional, Mirant will conduct impingement mortality studies beginning in June 2006. Mirant intends to review the historic impingement data in order to evaluate the reduction in impingement from retirement of the Units 1-5 offshore intake structure. It was reported that the offshore configuration of the Units 1-5 intake structure and its associated long intake channel impinged fishes at a higher rate than the shoreline intake structure of Units 6&7.

4.4.1 Conducting Proposed Impingement Mortality Study

Consistent with the Phase II Rule, Mirant will characterize the CCPP’s impingement mortality using contemporary data scheduled to be collected each week from June 2006 through May 2007. The Impingement Mortality Study Plan is provided in Appendix A.

5.0 Summary of Past or Ongoing Consultation with Agencies

The Phase II Rule requires that "a summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to the CDS and a copy of written comments received as a result of such consultations" be provided. 40 CFR 125.95(b)(1)(iii). Copies of written comments regarding agency consultations are provided in Appendix D.

To operate the CCPP, water is pumped from the estuarine reach of the San Joaquin River and circulated through the plant to cool critical generation equipment. As a result fishes may be impinged or entrained. The delta smelt, subject to U.S. Fish and Wildlife Service (USFWS) jurisdiction under the Endangered Species Act (ESA) and the California Department of Fish and Game under the California Endangered Species Act (CESA), and certain protected anadromous species[16] subject to the jurisdiction of the National Marine Fisheries Service (NMFS) and CDFG may be found in the vicinity of CCPP. The following section summarizes past consultations with federal and state fish and wildlife agencies; there have been no consultations with any tribal fish agencies. These consultations concerned both CCPP as well as the Pittsburg Power Plant (PPP) (collectively, the "Delta Plants"), another Mirant generating facility located approximately 12 miles downstream in Suisun Bay.[17]

Under the ESA, after the delta smelt was listed as threatened in 1993, Pacific Gas and Electric (PG&E), the previous owner of the Delta Plants, met with the USFWS and NMFS (collectively, the "Services") to initiate a habitat conservation plan (HCP) process under Section 10 of the ESA. A draft HCP was issued and revised several times from 1993 to 1997.

During the same period, PG&E completed two agreements with CDFG pursuant to the CESA: an agreement addressing impacts to striped bass, a nonnative, non-listed, but popular sport fishing species; an agreement providing incidental take authorization for delta smelt.

In 1995, the striped bass agreement was finalized (See Appendix D for a copy of the striped bass agreement). It provided for monitoring and mitigation payments related to the entrainment of larval striped bass during the period May–July each year. The term of the striped bass agreement

[16] These include Chinook salmon and steelhead.

[17] The Pittsburg Power Plant (PPP) is within the jurisdiction of the San Francisco Regional Water Quality Control Board. Mirant will submit a timely NPDES permit renewal application for the PPP in November 2006. Mirant is currently preparing a PIC for 316(b) compliance for the PPP and anticipates submitting it to the San Francisco Regional Board in May 2006 in order to meet the January 2008 regulatory deadline. Mirant anticipates that the 316(b) studies prepared for the two plants will be coordinated to some extent given their geographical proximity and the fact that past fish and wildlife agency consultations have addressed both plants together.

extended until 2000 or after the last mitigation payment was made in 2001. In 2002, Mirant and CDFG exchanged and discussed a draft striped bass agreement to be implemented after the 1995 agreement expired. Mirant is continuing to voluntarily implement the 1995 agreement.

In 1997, the memorandum of understanding (MOU) addressing the delta smelt and allowing PG&E to operate the plants in compliance with CESA was signed (See Appendix D for a copy of the MOU). The MOU incorporated mitigation measures contained in the then-extant draft HCP, including installation and testing of the Aquatic Filter Barrier (AFB), seasonal variable speed drive (VSD) operation, restoration activities at the nearby Montezuma Enhancement Site, and a mitigation payment system. The MOU expires in 2012.

In 2001, after several rounds of further revision to the draft HCP and after Mirant acquired the Delta Plants from PG&E, representatives of the Services stated that, due to staff and budgetary constraints, they could not commit to a specific time frame for completing the HCP process under Section 10 of the ESA. The Services instead recommended that Mirant apply for permits under Section 404 of the federal Clean Water Act from the U.S. Army Corps of Engineers (COE). This approach, the Services indicated, would allow them to review the minimization and mitigation measures proposed in the HCP in the context of the Section 7 ESA consultations that would be triggered by the Section 404 applications.

In March 2001, Mirant applied to the Sacramento office of the COE for a Section 404 permit. The Sacramento COE initiated Section 7 consultations with the Services in April 2001.[18]

In October 2002, NMFS issued a biological opinion pursuant to Section 7 of the ESA (See Appendix D for a copy of the NMFS biological opinion). The USFWS issued a similar biological opinion in November 2002 (See Appendix D for a copy of the USFWS biological opinion).

The primary minimization and mitigation measures identified in both biological opinions and which were adopted from the then-extant HCP included:

(1) Installation and evaluation of the AFB at CCPP during February 1 through July 31 for a period of three years;

(2) During February 1 through July 31 of each year, the implementation of VSD measures at PPP (to reduce intake by 20% below design flows) and as a "backup"

[18] Mirant also applied to the San Francisco office of the COE in July 2001 for permits to perform maintenance dredging and to install an AFB at PPP if the AFB proved to be successful at CCPP. Section 7 consultations regarding the PPP Section 404 application were initiated by the San Francisco COE in August 2001.

at the CCPP (to reduce Unit 1-5 intake flows by 100% and Units 6&7 flows by 5% below design flow levels) if the AFB is unsuccessful or temporarily disabled;

(3) The enhancement and preservation of the Montezuma Enhancement Site; and

(4) Annual mitigation payments to be made to CDFG based on based on four factors (amount of exceedance of VSD flows by plants, percentage exceedance, smelt abundance near the plants, and smelt abundance in the Delta) not subject to an annual maximum amount per plant. (NMFS BO at 6-8 and 11-13; USFWS BO at 7-13).

The biological opinions contained certain provisions that required the reinitiation of Section 7 consultations in the event that the AFB proved to be unsuccessful or if other changed circumstances were to occur.

After the biological opinions were issued, Mirant applied to the CDFG for a consistency determination pursuant to California Fish and Game Code Section 2080.1.[19] In August 2003, CDFG denied Mirant's consistency determination request. The MOU, which provides incidental take authority for delta smelt, remains in place.

During the period from the issuance of the biological opinions up to the present time, Mirant fully implemented and complied with VSD requirements for the Plants, continued to proceed with the enhancement planning and preservation of the Montezuma Enhancement Site, and tendered the mitigation payments required by the biological opinions to CDFG. However, in 2001-2003, Mirant encountered difficulties with the implementation of an AFB at one of its plants in New York. Mirant met with the Services and CDFG in late 2003 to discuss the difficulties experienced in the New York application as well as related technical and biological concerns associated with the AFB. To address these issues, Mirant proposed to reduce intake flows at the two plants by implementing a new variable frequency drive (VFD) system at both Plants and by retiring additional units at PPP. These proposals would reduce annual plant flows by 65% from the design flows applicable at the time the smelt were listed in 1993 and by 55% from the annual VSD flow limits that are set forth in the 2002 biological opinions, assuming full VSD implementation at both Plants. Mirant also stated that it would be filing for additional dredging and maintenance permits from the Sacramento and San Francisco COE offices and that a biological assessment (BA) would be submitted in conjunction with these maintenance dredging applications.

[19] Mirant had also previously discussed pursuing an incidental take permit under Section 2081 of the California Fish and Game Code with CDFG.

In an April 9, 2004 letter to Mirant, NMFS stated that it considered the NMFS BO moot until permits for the 2001 COE applications were issued (See Appendix D for a copy of the NMFS letter).

In April 2004, Mirant confirmed by letters to the Services the identification of the species that would be evaluated in the BA. In June 2004, Mirant submitted COE Clean Water Act section 404 Nationwide Permit applications for dredging and maintenance to the Sacramento and San Francisco COE offices. The BA was sent separately in August 2004 (See Appendix D for a copy of the BA).

In September 2004, the USFWS agreed to append the 2002 Biological Opinion to incorporate the mitigation measures in the BA (See Appendix D for a copy of the USFWS letter). Specifically, the alternative mitigation measures included the following: (a) a commitment to retire PPP Units 1-4; (b) expanded fish entrainment monitoring efforts at both Delta Plants; (c) an analysis of entrainment effects after two years of monitoring, potentially leading to the implementation of additional measures to protect delta smelt; (d) a commitment to enhance the Montezuma site; and (e) a commitment to continue VFD controls throughout the year. Mirant has subsequently complied with all of the letter's terms and conditions, including the submission of: (a) an AFB status report; (b) an enhanced monitoring plan; and (c) an updated mitigation site preservation and management plan to state and federal agencies. Mirant also retired PPP Units 1-4.

On January 31, 2006, USFWS submitted a letter to the COE requesting the COE to reinitiate ESA Section 7 consultation with respect to the Delta Plants (See Appendix D for a copy of the USFWS letter). The COE formally reinitiated Section 7 consultation on February 16, 2006 (See Appendix D for a copy of the COE letter). Discussions are ongoing.

6.0 SCHEDULE FOR INFORMATION COLLECTION

Mirant plans to complete the PIC and CDS in compliance with the schedule provided in the Mirant's letters to the Water Board dated October 3, 2005, and March 2, 2006,[20] and consistent with the Phase II Rule. Pursuant to this schedule, the impingement mortality study will commence in June 2006. Preliminary results of the impingement mortality study will be provided to the Technical Working Group throughout the year-long study. The complete CDS will be submitted to the Water Board by January 8, 2008.

Assuming that the Water Board provides comments within the 60-day period suggested in the Phase II Rule, Mirant will make any necessary changes to modify the PIC within 30 days and provide a revised PIC to the Board by June 1, 2006. At this point, PIC information gathering will be initiated. The first major task will be to complete the impingement mortality study and analysis. Completing this study and analysis is critical in order for Mirant to make a final decision on compliance alternatives. It is anticipated this analysis will require approximately four months to complete after the impingement mortality characterization study and analysis is completed at the end of May 2007. Upon PIC approval, Mirant will also initiate work and discussions with appropriate State and Federal agencies to identify potential restoration projects of interest for use under compliance alternatives 3 and/or 5. Preparation of the CDS will be as follows:

- Entrainment – Because the capacity utilization rate is anticipated to be below 15%, the entrainment performance standard is inapplicable. In the event the capacity utilization rate exceeds 15%, the CDS will be based on use of Compliance Alternative 2. A Design and Construction Technology Plan, a Technology Installation and Operation Plan and a Verification Monitoring Plan will be prepared to address the various flow reduction measures that have been implemented at CCPP and discussed in Section 3.1.1 of this PIC.

- Impingement – As discussed in Section 3.1.2 CCPP will make use of Compliance Alternative 2 and take credit for the various flow reduction measures that have been implemented which will require use of the same CDS documents discussed for entrainment. However, also as discussed in Section 3.1.2 it has not yet been determined whether the flow reductions are sufficient to meet the impingement mortality reduction standard. This determination will be made after completion of the one year of impingement monitoring. Should it be determined that addition impingement mortality

[20] See footnote 5.

reduction measures are needed to comply the CDS document that may be required are as follows.

- Use of Compliance Alternative 1 – Should Mirant elect use of a Compliance Alternative 1 technology such as year round deployment of a barrier net or use of wide-slot wedgewire screens, no CDS documents will be required. Details of these technologies would be provided pursuant to 40 CFR sections 122.21(r)(2)(3) and (5) information as required by the Phase II Rule. It is anticipated it 3–4 months would be required to prepare this information.

- Use of Technologies or Operational Measures Under Compliance Alternative 3 or 4 – If technologies or operational measures are selected under Compliance Alternatives 3, it is anticipated that approximately six months would be required to review and complete a draft of the technology- and compliance-related CDS elements (e.g., Impingement Mortality Characterization Study, Design and Construction Technology Plan, Technology Installation and Operation Plan and Verification Monitoring Plan). If Compliance Alternative 4 is used for impingement only the Design and Construction Technology Plan, TIOP and Verification Monitoring Plan would be required.

- Use of Restoration Measures– If restoration measures are determined to be appropriate either alone or in conjunction with technologies under Compliance Alternative 3 or 4, it is anticipated that three to four months will be required to provide the information necessary that to prepare a Restoration Plan to meet the requirements of the Phase II Rule. Preliminary efforts are underway to identify potential projects and project scaling methods necessary to create a restoration plan.

- Compliance Alternative 5 - In addition to the analysis of technologies, operational measures and restoration measures discussed in Section 3.2 of the PIC, the selection of Compliance Alternative 5 would require the preparation of a Comprehensive Cost Evaluation Study and, if the Cost-Benefit test is used, a Benefit Valuation Study, as well. These additional elements would be prepared in the same timeframe as the other potentially applicable CDS elements.

At this point, the schedule will be dictated by completion of the impingement study, which is necessary to determine the extent of compliance. If the compliance alternative requires use of technologies, the need for laboratory or site-specific pilot studies are likely to be necessary.

The Phase II Rule recognizes that the CDS studies are an iterative process[21] and allows facilities to modify the PIC based on new information. Mirant may request Water Board approval of an amendment to this PIC, based on new information relative to technologies and operational measures, use of restoration measures, the outcome of the Phase II Rule litigation, or subsequent Agency guidance.[22] Such information may require modification of the currently proposed schedule.

[21] See 69 Fed. Reg. at 41235.

[22] EPA is currently in the process of preparing further guidance on the Phase II Rule. The California State Water Resource Control Board is considering issuing guidance on implementation of the Phase II Rule for California NPDES permits. Either of these potentially forthcoming policy guidance documents may affect Mirant's ultimate selection of a compliance alternative.

Clean Water Act Section 316(b)
Proposal for Information Collection for Mirant's Contra Costa Power Plant

Submitted In Compliance with 316(b) Regulatory Requirements for Cooling Water Intake Structures at Phase II Existing Facilities

Appendix A

Impingement Mortality Study Plan

Contra Costa Power Plant

316(b) Impingement Mortality Study Plan

April 2006

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1.0 INTRODUCTION

The Contra Costa Power Plant (CCPP), owned and operated by Mirant Delta, LLC (Mirant), is located on the estuarine reach of the San Joaquin River near the city of Antioch in Contra Costa County, California. The power plant is equipped with a once-through cooling water system that utilizes water withdrawn from the San Joaquin River. After passing through CCPP, the cooling water is returned to the river.

Site-specific entrainment and impingement studies were conducted at CCPP from 1978–1979 (PG&E 1981). The information from these studies was used in conjunction with engineering and operating criteria to evaluate alternative intake technologies for the CCPP in the 316(b) Demonstration Report (PG&E 1981). The conclusion of these studies was that no alternative intake technologies or changes to the operations of CCPP were required to reduce impacts to entrained or impinged fish species.

Mirant is proposing to conduct an impingement study CCPP that is designed to fulfill requirements of the Section 316(b) Phase II Rule of the federal Clean Water Act (CWA). Site-specific information will be collected on the composition and abundance of all fishes and macroinvertebrates that are impinged on the Units 6&7 intake screens. This impingement study is designed to characterize lengths and weights of all impinged fishes, decapods, and shrimps. Estimates of annual impingement will be calculated for all these species. Section 316(b) requirements are described below.

Section 316(b) of the Clean Water Act regulates cooling water intake structures and requires that "the location, design, construction, and capacity of cooling water intake structures reflect the best technology available [BTA] for minimizing adverse environmental impact." The U.S. Environmental Protection Agency (EPA) attempted to establish regulations in the mid-1970s, but these rules were set aside by the courts on procedural grounds. To make Section 316(b) decisions, permit writers relied on other cases and on EPA's (1977) informal draft "Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment: Section 316(b) P.L. 92-500." New regulations concerning existing facilities such as CCPP were promulgated February 2004. In California, the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board (Water Board) are authorized to implement the Section 316(b) requirement.

1.1 Technical Working Group

A Technical Working Group (TWG) will be assembled from staff from CDFG, USFWS, and NOAA Fisheries and other experts to assist the Water Board's staff in their review of the design and implementation of the CCPP 316(b) impingement mortality study. This team may meet periodically to discuss topics relevant to impingement study.

1.2 Organization of the Study Plan

Section 2.0 provides a description of CCPP, a characterization of the source water body, and a summary of the CCPP impingement study conducted in 1978–1979. Section 3.0 describes the sampling methodology and data analysis to be used in the final report.

2.0 DESCRIPTION OF THE CONTRA COSTA POWER PLANT AND CHARACTERISTICS OF THE SOURCE WATER BODY

The Contra Costa Power Plant (CCPP), owned and operated by Mirant, is located on the estuarine reach of the San Joaquin River near the city of Antioch in Contra Costa County, California (Figures 1 and 2). Section 2.1 describes the Contra Costa Power Plant and Section 2.2 describes the characteristics of the source water body.

2.1 Description of the Contra Costa Power Plant

The CCPP consists of seven natural gas-fired generating units. In 2001, Unit 8 was permitted and construction began. Construction was suspended in 2002, and is anticipated to resume in 2006. Units 1-3 and accompanying small house generating units were built in 1951 and retired in 1995. Units 4&5 were built in 1953 and, though they are no longer operated to generate electricity, they are currently operated as synchronous condensers to improve power reliability. Units 6&7 were built in 1964 and generate a total of 690 gross megawatts (gMW) of power. Unit 8 has a planned generating capacity of 530 gMW.[1] The energy output and design flows for CCPP Units 1-7 and combined-cycle Unit 8 are summarized in Table 1.

Units 6&7 are equipped with once through cooling which utilizes water withdrawn from the estuarine reach of the San Joaquin River; Unit 8 will reuse water discharged from either Unit 6 or Unit 7. Source waters for the CCPP cooling water system are characteristic of this part of the Estuary that separates the upstream, freshwater Delta from the downstream, saltwater bays. As built, the total cooling water design flow required to service Units 1-7 combined was approximately 685,200 gallons per minute (gpm), or 986.5 million gallons per day (MGD). Units 6&7 are each serviced by two circulating water pumps that each have a design flow of 152,800 gpm, or 220 MGD (Table 1). The total design flow for both Unit 6 and Unit 7 is approximately 305,600 gpm, or 440 MGD.

In addition to the Unit 6 and Unit 7 cooling water intake requirements, the CCPP utilizes water for station water supplies, for intermittent intake screen washing, and for fire suppression purposes. At maximum operation, these additional uses account for approximately 22 MGD. The total current design flow for all CCPP operations, including Unit 8, is approximately 462 MGD (Table 2). Thus the proportion of design intake flow used for cooling purposes in the cooling water system is 95% (i.e., 440/462).

[1] The Phase II Rule's preamble states that an existing facility is one that commenced construction as described in 40 CFR section 122.29(b)(4) on or before January 17, 2002.69 Fed. Reg. 41578. Since Unit 8 was permitted and construction initiated in 2001 it is part of the existing Phase II facility.

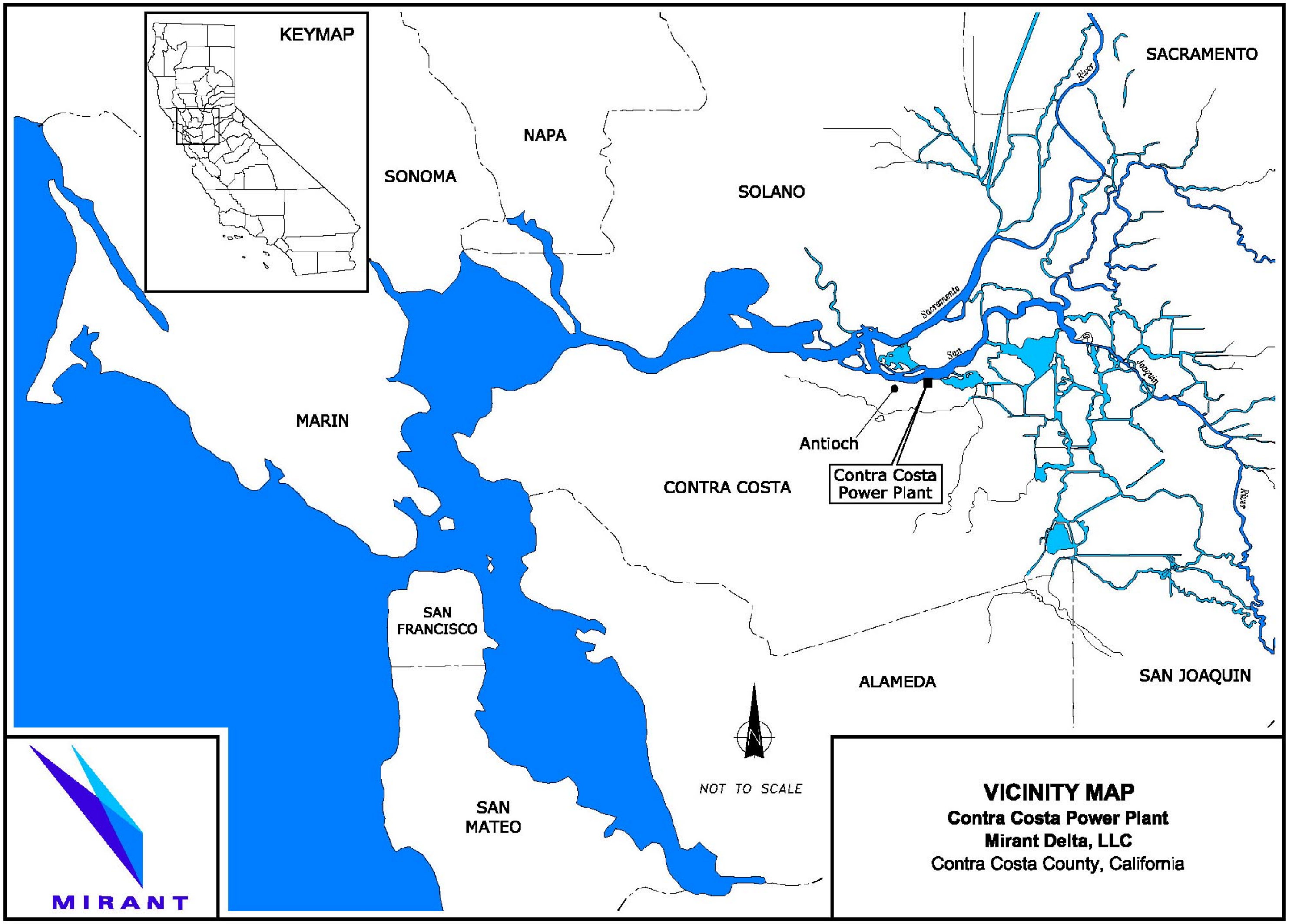

Figure 1. Overview of the Bay-Delta showing the location of the Contra Costa Power Plant.

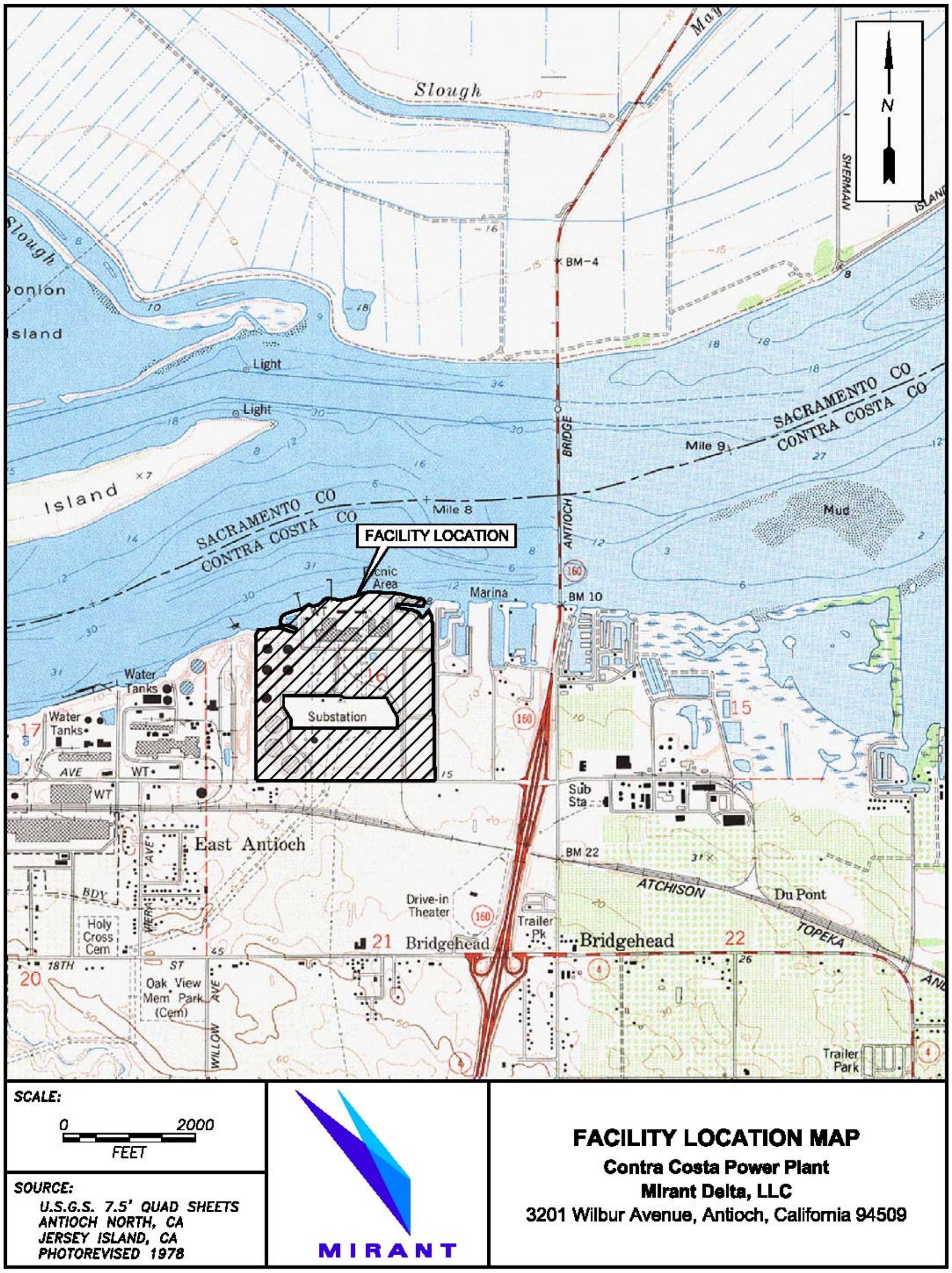

Figure 2. Property boundary of the Contra Costa Power Plant.

The number of days the cooling water system is in operation varies depending on the demand of California's electricity transmission grid. However, CCPP Unit 7 has been designated as a Reliability Must-Run (RMR) priority electrical generation facility by the California Independent System Operator (ISO). CCPP is important to the overall stability of the San Francisco Bay Area electrical grid. Under the terms of the RMR contract, CCPP Unit 7 must be available to provide 100% generating capacity if such power is required by the ISO at any time.

Further, CCPP Units 6&7 are both considered "Participating Generators" by the Federal Energy Regulatory Commission. The ISO set forth an implementation plan directing all non-hydroelectric generators to offer all available generation to the ISO real-time market at all times. Thus, CCPP Units 6&7 must offer generation during all hours if it is available and not already scheduled to run under another agreement.

Details of each of the water withdrawal systems are provided in the following sections.

Table 1. Electrical output and design cooling water flows for CCPP prior to 1995.

	Unit								
	1(1)	**2(1)**	**3(1)**	**4(2)**	**5(2)**	**6**	**7**	**Unit 8**	**Total**
Design Capacity (gMW)	113	113	113	122	120	345	345	**530(3)**	**1,801**
Current/Planned Capacity	0(5)	0(5)	0(5)	0(5)	0(5)	345	345	**530**	**1,220**
Design Flow (gpm)	89,600	89,600	89,600	55,400	55,400	152,800	152,800	**0(4)**	**685,200**
Design Flow (MGD)	129	129	129	80	80	220	220	**-**	**987**
Current/Planned Design Flow (gpm)	0	0	0	0	0	152,800	152,800	**-**	**305,600**
Current/Planned Design Flow (MGD)	0	0	0	0	0	220	220	**-**	**440**

(1) House units for Units 1-3 provided up to 27 gMW auxiliary power for internal use.

(2) Units 4 and 5 are currently used as synchronous condensers and the cooling water flows are provided by station service water.

(3) Unit 8 will generate 530 gMW when construction is completed.

(4) Unit 8 is designed to reuse water after circulation through Unit 6 or Unit 7. The table reflects the assumption that Unit 8 will operate at the same time that Unit 6 or Unit 7 operates and no additional water consumption is attributed to Unit 8. If Units 6&7 are not being operated, 38,200 gpm of water would be withdrawn through a single existing intake pump operating at half-speed to provide make-up cooling water to compensate for Unit 8 evaporation losses.

(5) Units 1-5 were retired in 1995.

Table 2. Total current CCPP design flow water use by subsystem.

	Flow (gpm)	Flow (MGD)
Circulating Water Pumps(1)		
Unit 6	152,800	220
Unit 7	152,800	220
Subtotal	305,600	440
Continuous Pumps		
Station Service Pumps	12,000	17.28
Jockey Pump (Fire Suppression)	20	0.029
Subtotal	12,020	17.309
Intermittent Pumps		
Units 6&7 Screenwash Pumps (2)	5,400	3.888
Fire Suppression (Main Pump) (3)	2,000	0.72
Subtotal	7,400	4.608
TOTAL	**325,020**	**462**

(1) Unit 8 is designed to reuse water after circulation through Unit 6 or Unit 7. The table reflects that Unit 8 will operate at the same time that Unit 6 or Unit 7 operates and no additional water consumption is attributed to Unit 8. If Units 6&7 are not being operated, 38,200 gpm of water would be withdrawn through a single existing intake pump operating at half-speed to provide make-up cooling water to compensate for Unit 8 evaporation losses.

(2) Assumes that all three screenwash pumps operate for two hours every four hours per day.

(3) The fire suppression pumps are always available for emergency situations. The normal operating flows are based on testing each pump up to one hour per week to assure pump reliability and to occasionally flush the header system. Flows are calculated assuming the main pump is used for 25% of the year.

2.1.1 Units 1-5 Cooling Water Intake System

Cooling water for Units 1-5 was historically withdrawn from the estuarine reach of the San Joaquin River at a point approximately 250 ft offshore through two 12-ft-diameter intake tunnels, which delivered cooling water to a conventional screenhouse onshore (Figure 3). The intake, at the offshore point of water withdrawal, is located at 38°01'14 North and longitude 121°45'45" West. The intake conduits rest on the bottom of the Estuary at a depth of approximately 22 ft below Mean Sea Level (MSL). Units 1-5 were retired in 1995 and no longer withdraw cooling water through the Units 1-5 intake structure. Units 4&5 are currently used as synchronous condensers, a function that does not require water from the Plant's circulating water pumps. When the Units 1-5 circulating water pumps were operated, flow through the intake structure was up to 550 MGD. With retirement of Units 1-5, the maximum daily flow through the intake structure is 10 MGD (less than 2% of the original flow), which is provided by station service water.

The Units 1-5 intake consists of bar racks and traveling screens. Two bar racks, each approximately 26 ft 9.5 in. long and spaced 3.75 in. on center are located about 250 ft in front of the vertical traveling screens and prevent the entry of large objects into the cooling water system. Five vertical traveling screens with a mesh size of 3/8 in. retain smaller objects. Each traveling screen is approximately 10 ft 4.75 in. long and 2 ft wide, and is comprised of screened “panels”. Units 1-5 traveling screens no longer operate since only the low volume station service water is withdrawn through the structure.

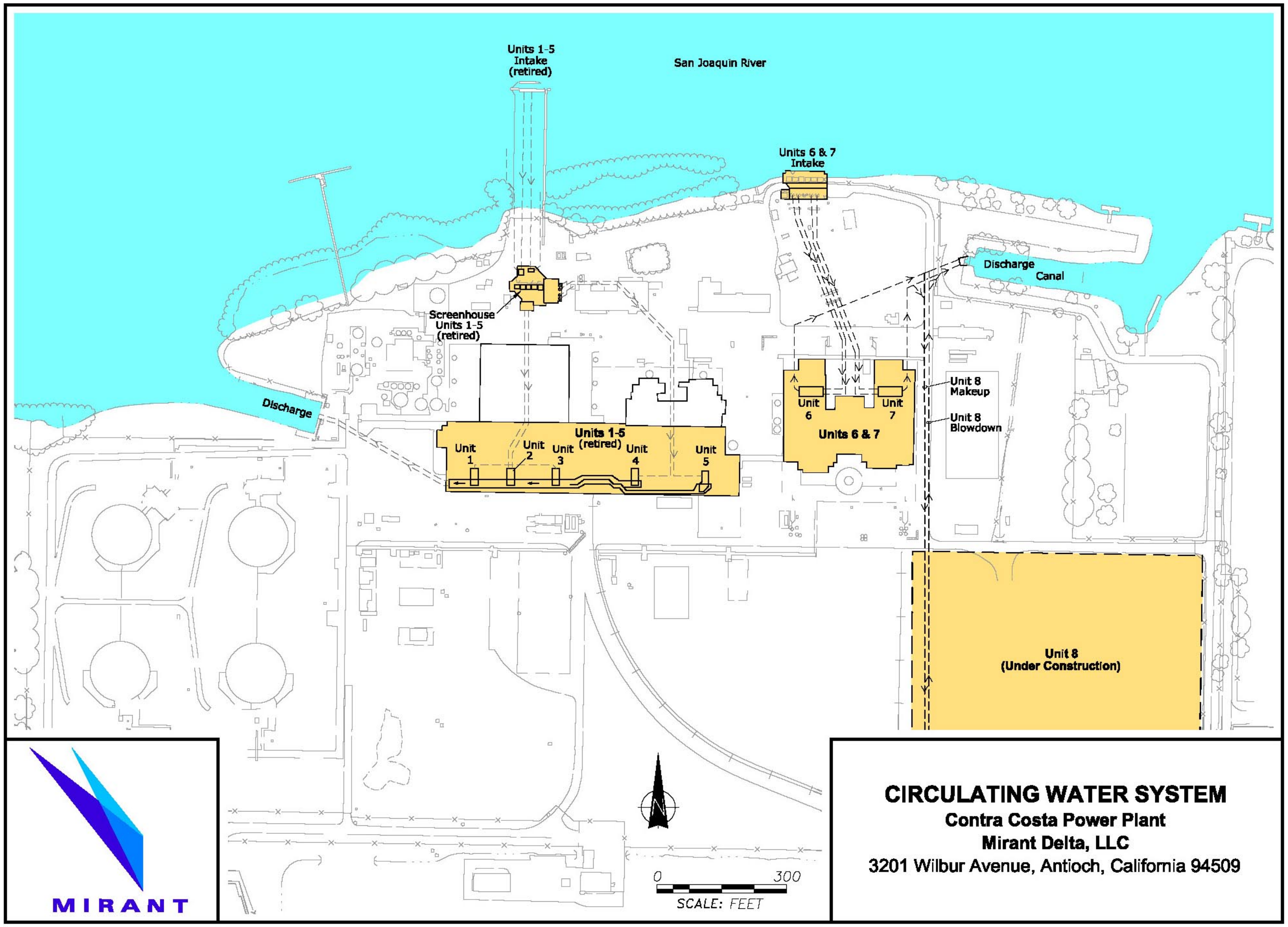

Figure 3. General configuration of the Contra Costa Power Plant cooling water system.

Each of the units was equipped with two circulating water pumps that supplied cooling water to the unit's steam condenser. Units 1-3 circulating water pumps had a capacity of 44,800 gpm each, and those serving Units 4&5 had a capacity of 27,700 gpm each.

Units 1-3 circulating water pumps also supplied cooling water to their respective house unit steam condensers. In addition, Units 1-3 had four 3,000-gpm auxiliary pumps (also referred to as station service pumps) that supply water for other unit needs. Two of the four auxiliary pumps usually provided an adequate supply of water for these other needs. Under design maximum operating conditions, the combined flow rate of Units 1-5 was 391,600 gpm. The volume of water from the auxiliary pumps constituted less than 3% of the Units 1-5 cooling water flow. The auxiliary pumps continue to supply water for Units 4&5 synchronous condenser operation, boiler water makeup, and other auxiliary system needs.

Table 3 provides design water velocities from several locations in the Units 1-5 intake structure. When all circulating water pumps were operating, the design water velocity through the traveling screens was 2.6 feet per second (fps).

Table 3. Design water velocities estimated at full circulating water pump flow for several points throughout the Units 1-5 intake structure.

	Design Water Velocities (fps)
Through intake tunnel	3.8
Approach to bar racks	2.7
Through bar racks	3.6
Approach to screens	1.3
Through screens	2.6

2.1.2 Units 6&7 Cooling Water Intake System

The Units 6&7 intake structure is located on the shoreline approximately 600 ft east of the Units 1-5 intake structure (Figure 3). The bottom of the intake structure is approximately 14 ft below Mean Sea Level. The latitude and longitude coordinates of the Units 6&7 intake structure are 38°01'12" North and longitude 121°45'36" West. The intake facility is a concrete structure that includes bar racks, traveling screens, and circulating water pumps. Separate intake conduits deliver cooling water to the Unit 6 and Unit 7 condensers. The cooling water flows from each unit are kept separate from each other and are ultimately directed into a discharge channel. The discharge channel joins the Estuary approximately 800 ft east of the Units 6&7 intake structure.

The major features of the Units 6&7 intake structure are shown in Figure 4. Six bar racks, each approximately 22 ft long and spaced 4.0 in. on center, are located about 15 ft in front of the vertical traveling screens system and prevent the entry of large objects into the cooling water system. Six vertical traveling screens with a mesh size of 3/8 in. retain smaller objects. Each traveling screen is comprised of 30 screened “panels.” Each panel is approximately 10 ft wide and 2 ft tall.

Table 4 provides design water velocities from several locations in the Units 6&7 intake structure. When all circulating water pumps are operating at full flow, the design water velocity through the traveling screens is 1.5 fps.

Table 4. Design water velocities estimated at full circulating water pump flow for several points throughout the Units 6&7 intake structure.

	Design Water Velocities (fps)
Approach to bar racks	0.6
Through bar racks	0.7
Approach to screens	0.8
Through screens	1.5

Debris, along with fishes and invertebrates retained by the screens, is removed during the screen rotation and washing, which is initiated either by a timer at about 4-hour intervals under normal operating conditions or when the across-screen hydraulic differential exceeds a predetermined maximum. The traveling screens are rotated and rinsed whenever the circulating water pumps are operating.

During screen washing, high-pressure (110-psi) spray nozzles wash debris and impinged organisms into a surrounding sluiceway that empties into a screen refuse sump. Two screen refuse pumps withdraw the impinged material by suction and convey it to the circulating water discharge tunnel. The pumps are vertical dry pit refuse pumps, centrifugal, enclosed impellers, which will pass a 6-inch diameter sphere.

The screenwash discharge is returned to the Estuary by large-diameter pumps. The centrifugal vertical open-impeller pumps are activated sequentially as the wet well fills with screenwash by pedestal float switches, and they run until the well is empty. The pumps discharge into an 18-in. diameter concrete pipe that empties into the discharge conduit of Unit 6.

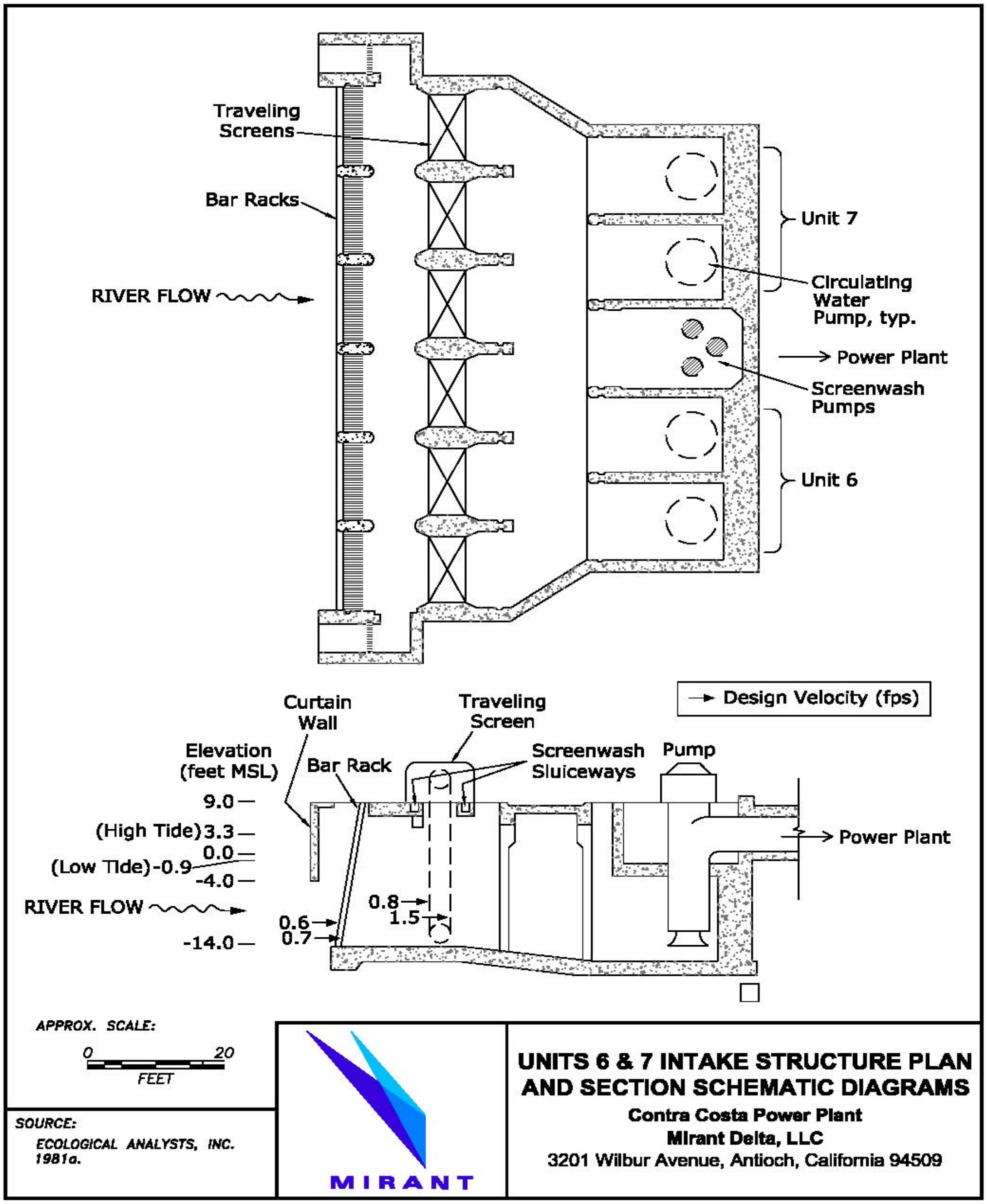

Figure 4. Plan and section schematic diagrams of the Contra Costa Power Plant Units 6&7 intake structure.

Each unit's two 76,400 gpm circulating water pumps are run simultaneously and furnish 305,600 gpm of cooling water to the Units 6&7 condensers. Single-pump operation occurs only during maintenance inspections and outages. In single-pump operation, electrical generation is limited to less than 50% of a unit's maximum capacity. These pumps were initially retrofitted with Variable Speed Drive (VSD) controls in 1987, allowing them to be operated from 50% to 95% of their rated capacity. In early 2004, the VSD controls were replaced with updated Variable Frequency Drive (VFD) technology. When operating in VFD mode, the circulating water pump speed/flow is typically at its minimum level when the unit is at minimum load. The minimum circulating water pump speed/flow is set at 50% of design flow. The minimum circulating water pump speed/flow may vary due to the temperatures of the intake water or the cleanliness of the condenser tubes (commonly measured as backpressure). In general, the minimum circulating water pump speed/flow will be between 50–60% of design flow at loads less than 65 gross megawatts (gMW). As unit load increases, pump speed and flow are increased in accordance with unit conditions. The VFD control procedure is written as follows:

> There are two modes of VFD operation depending on the time of year. Generally, from May 1 to July 15, a feed forward curve controls the circulating water pump (CWP) speed at 50% speed until 172 MW is achieved. The speed then gradually ramps to 95% speed at 322 MW. The speed is maintained at 95% through a full load of 345 MW. A discharge temperature setpoint of 85ºF also cascades into the control logic to increase or decrease the pump speed as needed. The pump speed is always maintained for minimum flow and optimum temperature (<86ºF) in the range of 50 to 95% except in the rare occurrence when a condenser backpressure greater than 2.0 inches Hg is impacting the reliability of the unit. Except during conditions of electrical grid system reliability as dictated by the Independent System Operator (ISO), the unit load is reduced to prevent pump speed from exceeding 95% due to either exceeding a backpressure of 2.0 inches Hg or exceeding discharge temperature of 86ºF.
>
> During the remainder of the year, a feed forward curve maintains 50% of speed until 65 MW when the speed is gradually ramped to 95% at 115 MW. The 95% speed curve is maintained through full load at 345 MW. Turbine backpressure is cascaded into the control logic to allow a maximum backpressure of between 0.8 and 1.8 in Hg between 50 and 345 gross MW. Exceeding the turbine backpressure curve will allow the pump speed to exceed the feed forward curve.

2.1.3 Unit 8

The closed-cycle cooling water system designed to serve Unit 8 is depicted in Figure 3. This closed-cycle system is designed to use a mechanical-draft, wet cooling tower to dissipate the heat transferred to the cooling water flow during transit through the steam condensers. In a closed-cycle system, "makeup" water is withdrawn from a source to replace cooling water that evaporates in the cooling tower or is carried away in small droplets (drift) and to control the dissolved solids content of the cooling water. The portion of the cooling water returned to the source water body, with its typically higher concentration of minerals, is called blowdown. The ratio of the water returned (blowdown) to water withdrawn (makeup) depends on a number of factors affecting the rate of evaporation, including air temperature, humidity, and wind.

The new unit includes a closed-cycle mechanical draft cooling tower utilizing a maximum of 7,630 gpm of make-up water from the existing discharge water of cooling water from Units 6 and/or 7. With the retirement of Units 1-5, design circulating water flows are 440 MGD, with an additional 22 MGD for auxiliary systems. Unit 8's reuse of Units 6&7 cooling water will not increase the volume of water withdrawn from the Estuary. Unit 8 will draw its cooling water supply from the existing cooling water flow of Units 6&7. In the event Units 6&7 are not operating when Unit 8 is in operation, one circulating water pump will run at reduced speed/flow. The reduced flow will be the lowest pump flow possible (38,200 gpm) to provide the minimum cooling tower make-up water required at the time (maximum 7,630 gpm) plus sufficient flow to meet the NPDES flow relationship for Outfall 002 (15%). The utilization of Unit 8 will thus greatly reduce the amount of cooling water withdrawn from the Estuary.

CCPP Unit 8's combined cycle power unit consists of two natural gas-fired combustion turbine generators, two heat recovery steam generators (HRSGs), and a steam turbine generator. In the combined cycle process, electricity is created from the combustion turbines and the steam turbine. Natural gas is burned to fire the combustion turbines. Exhaust heat from the two combustion turbines is then used to generate steam in the HRSG, which in turn drives the steam turbine electricity generator. The combined cycle process creates electricity more efficiently and creates less pollution than conventional power systems.

2.1.4 Station Service, Intake Screenwash, and Fire Suppression Water Systems

There are three relatively low-volume or intermittent-use water systems at the CCPP that withdraw Delta water in addition to the cooling water system of Units 6&7. These three systems are the station service, intake screenwash, and fire suppression water systems.

The station service water system withdraws water from the Units 1-5 intake structure for use as bearing cooling water for Units 4&5 synchronous condensers and for the water treatment systems for Units 6, 7, and 8. There are a total of four station service water pumps each having a design-rated capacity of 3,000 gpm. During normal operation, one pump is operated continuously for 24-hours per day to provide a total of 3,000 gpm of station service water. Maximum station service water flows would be with four pumps operating at a total of 12,000 gpm.

The intake screenwash system supplies water for removing debris from the traveling screens at the Units 6&7 intake structure. The intake structure is equipped with three screenwash pumps. During normal operation, two screenwash pumps per intake structure are operated for 15 minutes once every 4 hours for a total of 90 minutes per 24 hours. Each intake structure's third screenwash pump is in "stand-by" mode, and is available for service if required. The rated design capacity of each screenwash pump is 1,800 gpm (4 cfs). During normal operation two screenwash pumps per intake operated for a total of 90 minutes per day.

CCPP's fire suppression system consists of three pumps that are always available for emergency situations. A main fire pump (2,000 gpm) and a diesel fire pump (2,000 gpm) are available for use when required. There are two jockey pumps (each 20 gpm used to provide pressure to the fire suppression system. During normal operation, one jockey pump runs continuously 24 hours/day and the other jockey pump is in stand-by mode. Typically each pump is tested up to one hour per week to assure pump reliability and to occasionally flush the header system. Thus, normal operating flows assume about 4 hours/month per pump (0.133 hours/day).

2.2 Characteristics of the Source Water Body

2.2.1 Physical Characteristics

The aquatic environment near CCPP fluctuates between a typically freshwater environment in periods of high freshwater inflow and a brackish-water environment when freshwater outflow is low. Seasonal changes in water temperature and salinity affect species composition and abundance of the aquatic community in the area. Water quality in the vicinity of CCPP, as in the Delta, is influenced primarily by freshwater inflow and tidal circulation. Tidal flow entering the Delta from Suisun Bay influences both the Sacramento and San Joaquin river systems. Tides are semidiurnal, with two flood and two ebb phases per 24.8-hour tidal day. Mean tidal range at Antioch is about 3.3 ft. The average tidal flow in front of the Plant is approximately 170,000 cfs (4,800 m^3/s) (PG&E 1970). The effective volume of water that moves back and forth past the area depends on tidal conditions and freshwater inflow, and has been assumed to be equal to the tidal prism, i.e., the quantity of water passing the Plant between successive tidal phases minus the Delta outflow, calculated as approximately 1.3 billion ft^3 (37 million m^3) (Tetra Tech 1976). Tidal currents within the Delta reverse direction between flood and ebb tide cycles, which has a substantial effect on the size and location of the thermal discharge plume of CCPP.

Hydraulic characteristics of the mixing zone between freshwater flowing into the Delta from the Sacramento and San Joaquin river systems and saltwater intrusion from San Francisco Bay is described by a zone of particle accumulation frequently referred to as the "null zone." Data from Arthur and Ball (1978, 1979) and Kimmerer (1991) have shown that the location of the null zone can be defined by surface salinities ranging from approximately 1–6 ppt. These studies have also shown that the location of the null zone, as defined by salinity conditions, varies in response to changes in freshwater inflow. During periods of low inflow (e.g., 3,500–5,000 cfs), the null zone is located adjacent to the CCPP. The magnitude of freshwater inflow during late winter and spring influences the location of the null zone and the geographic distribution of larval delta smelt *Hypomesus transpacificus* and other species of concern, thereby affecting their susceptibility and exposure to the cooling water systems at the power plant.

2.2.2 Aquatic Habitats and Species in the Vicinity of CCPP

Source waters for the CCPP cooling water system are characteristic of the Estuary that separates the upstream, freshwater Delta from the downstream, saltwater bays. The areas adjacent to the Plant contain several types of aquatic habitats, including freshwater and brackish marshes, shallow channel and shoal areas, and the main river channel. Together, these habitats support a diverse aquatic community.

The islands north and west of the CCPP consist of brackish and freshwater marshes. The CCPP site is industrial in nature and most of the area has been paved or covered with concrete. The shoreline has been straightened and the banks have been riprapped. Generally riparian vegetation is absent on the shoreline. The area between the shore and the deepwater channel is characterized by water depths of less than 20 ft, a mud, sand, or peat-detritus bottom, and reduced exposure to tidal and river currents. The inshore areas of the shoals and the shoreline are bordered by relatively sparse emergent vegetation. Small crustaceans, particularly mysid shrimp *Neomysis mercedis* and amphipods of the genus *Corophium*, inhabit the area and are important food items for young-of-the-year fishes. Fish species occurring in the shallow channel and shoal areas adjacent to the power plant include striped bass *Morone saxatilis*, largemouth bass *Micropterus salmoides*, Chinook salmon *Oncorhynchus tshawytscha*, longfin smelt *Spirinchus thaleichthys*, delta smelt, wakasagi *H. nipponensis* , threespine stickleback *Gasterosteus aculeatus*, tule perch *Hysterocarpus traski*, Sacramento pikeminnow *Ptychocheilus grandis*, gobies (e.g., *Acanthogobius flavimanus, Tridentiger bifasciatus*), inland silverside *Menidia beryllina*, starry flounder *Platichthys stellatus*, Sacramento splittail *Pogonichthys macrolepidotus*, common carp *Cyprinus carpio*, and catfish *Ictalurus* spp. (PG&E 1981).

River and shipping channels are characterized by depths of more than 20 ft and by strong tidal and river currents (1.1–1.5 fps). Dredged shipping channels are present on the opposite side of the river from the CCPP. The river bottom is generally comprised of fine silts and sand. Invertebrates that inhabit this area include bottom-dwelling polychaetes, amphipods, bivalves, and epibenthic shrimp, primarily *Neomysis mercedis*, *Palaemon macrodactylus*, and *Crangon* spp. The open waters of the lower San Joaquin River serve as a migratory route for several species of anadromous fishes that migrate to the freshwater reaches of the tributary rivers to spawn. These fishes include striped bass, steelhead, Chinook salmon, white and green sturgeon

Acipenser transmontanus and *A. medirostris*, and American shad *Alosa sapidissima*. Many other estuarine and freshwater fishes, including Sacramento pikeminnow, catfish, longfin and delta smelt, common carp, and Sacramento splittail, occur in these areas.

Three species of threatened and endangered (T&E) species have been identified by NOAA Fisheries and USFWS to be in the vicinity of CCPP, and therefore, possibly affected by CCPP operations. These species are delta smelt *Hypomesus transpacificu*s, winter-run and spring-run Chinook salmon *Oncorhynchus tshawytscha*, and Central Valley and Central California Coast steelhead *Oncorhynchus mykiss*. Threats to the Delta aquatic ecosystem include loss of habitat due to decreased freshwater inflows that have increased salinity; loss of shallow-water habitat due to dredging, diking, and filling; pollution; introduced aquatic species that have disrupted the food chain; entrainment; and altered patterns and timing of flows through the Delta resulting from state, federal and private water diversions. In listing a number of Delta fishes as threatened under the ESA, the USFWS, concluded that population declines were due to a number of factors. The primary identified threats were "changes in water flows and water quality resulting from the export of water from the Sacramento and San Joaquin rivers, periodic prolonged drought, loss of shallow-water habitat, introduced aquatic species, and agricultural and industrial pollutants." At the time delta smelt were listed by USFWS in 1993, their population had decreased by approximately 90% from historic numbers (58 Fed. Reg. 12,863 (March 5, 1993)).

These threats also led to the development of the *Sacramento-San Joaquin Delta Native Fishes Recovery Plan* (USFWS 1996) for seven fish species in the Delta. The seven species, delta smelt, Sacramento splittail (since proposed for delisting), longfin smelt, green sturgeon, Sacramento perch *Archoplites interruptus*, and spring-run and fall/late fall-run chinook salmon, depend on the Sacramento-San Joaquin Delta for a significant segment of their life history. The recovery plan identifies the following actions needed for recovery for these species:
(1) enhancing and restoring aquatic and wetland habitat in the Sacramento-San Joaquin Delta, (2) reducing effects of commercial and recreational harvest, (3) reducing effects of introduced aquatic species on native Delta fishes, (4) changing and improving enforcement of regulatory mechanisms, (5) conducting monitoring and research on fish biology and management requirements, (6) assessing recovery management actions and reassessing prioritization of actions, and (7) increasing public awareness of the importance of native Delta fishes.

Sacramento River winter-run chinook salmon and Central Valley steelhead, two other listed fish species that utilize the Delta, are not included in the Delta Fishes Recovery Plan, but are addressed in the *Recommendations for the Recovery of the Sacramento River Winter-run Chinook Salmon* (NMFS 1996) and the *Steelhead Restoration and Management Plan for California* (CDFG 1996), respectively.

Natural Delta inflow consists of rain runoff during late fall and winter and snowmelt in spring and summer. The major rivers that drain into the Delta are dammed for flood control, water storage, and hydroelectric power generation. The current Delta system is a highly controlled and modified environment. The Estuary serves as a water source for local agriculture, industries and municipalities, and state and federal water diversion facilities. The principal mechanism for control of water entering the Delta is through a pair of independent, yet coordinated and cooperative water systems: the CVP operated by Reclamation, and the SWP operated by DWR. During periods of low Delta inflow, state and federal water exports can alter the direction of flow (reversed flow) in the lower San Joaquin River adjacent to the CCPP and in many Delta channels. The balance between diversion of freshwater from the Delta and water storage and release from the reservoirs plays a critical part in the regulation and control of physical, chemical, and biological processes in the Estuary. The release of stored water during the summer and fall dry seasons has considerably altered the freshwater flow and salinity regimes in the Delta. At the same time, diversions from the Estuary of freshwater inflow have altered the total freshwater input to the San Francisco Bay/Delta and the patterns of flow and salinity. Freshwater flow patterns are important to the physical, chemical, and biological processes of the Bay/Delta system. Seasonal reductions in Delta inflow, as a consequence of upstream storage within impoundments and increased diversions and consumptive use, have been identified as major factors affecting the abundance of a variety of Delta fishes and macroinvertebrates.

Increased diversions, especially in dry years, result in a reduction in both total outflow and high spring outflows. These reductions can affect salinity, the location of the mixing zone, river flow direction, primary productivity, and survival of larval and juvenile fishes. During periods of drought and increased water diversions, the mixing zone is shifted further upstream in the Delta. Between 1984 and 1993, with the exception of record flood flows of 1986, the mixing zone has been located primarily in the river channels during the entire year because of increased water exports and diversions (58 Fed. Reg. 12,854 (Final Rule listing delta smelt as threatened) (March 5, 1993)). Beginning in 1995, mean monthly flows began to increase and the location of the mixing zone in the Delta moved downstream (IEP 1999). When located upstream, the mixing zone becomes confined to the deep river channels, becomes smaller in total surface area, contains very few shallow areas suitable for spawning, may have swifter, more turbulent water currents, and lacks the high zooplankton productivity that is present in the shallow waters of Suisun Bay. In all respects, the upper river channels provide much less favorable spawning and rearing habitat for delta smelt than that provided when the mixing zone occurs further down where it occupies a large geographic area and includes extensive shallow areas that provide suitable spawning substrates within the euphotic zone (depths less than 4 m).

Channelization and dredging of Delta waterways in combination with levee construction and reclamation have contributed to changes in water velocities, residence time, hydrologic patterns, and the areal extent of shallow water, shoals, and marsh habitats. The availability of shallow water and marsh habitats within the Delta, which historically provided habitat for a variety of species, has been reduced substantially through reclamation of Delta islands for agricultural use and the filling and diking of areas for industrial and residential use. These changes to the Delta environment have resulted in significant modifications and reductions in habitat availability and suitability for aquatic and terrestrial species.

Data on the status of various aquatic organisms inhabiting the Estuary system show a number of changes in species composition and relative abundance of fish and macroinvertebrate populations (Moyle and Herbold 1989, Herbold et al. 1992, and CDFG 1993). Results from these studies have demonstrated the introduction and rapid increase in abundance of fish species such as yellowfin goby and invertebrates including the copepods *Pseudodiaptomus forbesi, Limnoithona tetraspina,* and *Sinocalanus doerri* and the clam *Corbula amurensis* during the past decade. Abundances of the copepods *Eurytemora affinis* and *Diaptomus* spp., mysid shrimp *Neomysis mercedis*, and shrimp (*Palaemon macrodactylu*s and *Crangon franciscorum*) have declined in recent years (Herbold et al. 1992).

2.3 1978–1979 Impingement Study

In response to the requirements of Section 316(b) of the Clean Water Act, Pacific Gas and Electric (PG&E) conducted an intensive study in 1978–1979 (PG&E 1981) of the entrainment and impingement of fishes and macroinvertebrates resulting from the operation of the CCPP cooling water system. Section 316(b) required that the "location, design, construction, and capacity of cooling water intake structures reflect the best technology available (BTA) for minimizing adverse environmental impacts" (EPA 1977). The entrainment and impingement studies, required by the plant's NPDES Permit, provided a basis for regulatory and resource agencies to evaluate the cooling water intake system impacts and assess any modifications needed to minimize adverse environmental impacts. The impingement study is summarized below.

Impingement studies were conducted at CCPP to provide a quantitative assessment of the numbers of fishes and macroinvertebrates impinged and lost to the local population due to the operation of the CCPP cooling water system. The study was designed to determine the species composition, lengths and weights, and sex ratio and maturity of the impinged organisms. Also of interest were diel and seasonal patterns of impingement, the probability of impingement at the bar racks, and the relationship between plant operation and impingement. An additional study, fish pump efficiency, was conducted to determine the effectiveness of the installed Units 1-5 fish pump system in reducing impingement.

The objectives of the impingement abundance study were to:

- Determine the species composition of the organisms impinged,
- Determine the lengths and weights of impinged organisms,
- Determine the sex and gonadal maturity of selected organisms,
- Determine diel and seasonal patterns of impingement,
- Examine the relationship between plant operation parameters and impingement rates, and
- Assess the occurrence of impingement on the bar racks.

Impinged fishes and macroinvertebrates, and debris were washed off the vertical traveling screens and into screenwash sluiceways where the material ultimately was collected in sampling baskets at the lower end of the sluiceway.

Results

Impingement estimates of the most commonly impinged fishes and macroinvertebrates for the period April 1978 through April 1979 based on actual pump operation are provided in Table 5. Annual fish impingement estimates for 1978 at Units 1-5 were approximately 219,000 and 108,000 for Units 6&7 (Table 5). For 1979 (from May 1979 to January 1980) fish impingement estimates based on actual pump operation for Units 1-5 were 587,000 and for Units 6&7 were 86,000 (Table 6). Included in the Units 1-5 estimates for 1979 were extrapolated estimates of fish removed by fish pumps. This extrapolation was based on continuous fish pump operation.

The seven most abundantly impinged fish species accounted for approximately 94% of the fishes collected during April 1978–April 1979 (both intakes combined). These included: the striped bass *Morone saxatilis*, threadfin shad *Dorosoma petenense*, American shad *Alosa sapidissima*, yellowfin goby *Acanthogobius flavimanus*, longfin smelt *Spirinchus thaleichthys*, Sacramento splittail *Pogonichthys macrolepidotus*, and white catfish *Ictalurus catus*. The four fish species most commonly impinged, striped bass, threadfin shad, yellowfin goby, and American shad, constituted 85% of the estimated impinged fishes in the April 1978–April 1979 study and 96% in the May 1979–January 1980 study (both intakes combined).

Estimated annual impingement of macroinvertebrates under actual pump operation was 179,000 for Units 1-5 and 141,000 for Units 6&7 during the April 1978–April 1979 study (Table 5). Estimates for the May 1979–January 1980 study were 297,000 for Units 1-5 and 209,000 for Units 6&7 (Table 6). The most frequently impinged macroinvertebrates during both the 1978 and 1979-1980 study were the oriental shrimp *Palaemon macrodactylus*, bay shrimp *Crangon franciscorum*, and the pebble crab *Rhithropanopeus harrisii*.

Table 5. Estimated numbers of selected fishes and macroinvertebrates impinged at the CCPP under actual pump operation: April 1978 – April 1979.

Taxon		Units 1-5			Units 6&7			Total Units 1-7			
Common Name	Scientific Name	Number Impinged	Standard Error	Weight (kg)	Number Impinged	Standard Error	Weight (kg)	Number Impinged	Percent	Weight (kg)	Percent
Fishes											
Striped bass	*Morone saxatilis*	93,059	13,567	1,101.8	43,090	5,721	314.7	136,149	41.6	1,416.5	39.7
Threadfin shad	*Dorosoma petenense*	66,129	5,936	525.6	41,099	11,509	173.9	107,228	32.8	699.5	19.6
American shad	*Alosa sapidissima*	17,265	2,995	115.8	2,337	408	27.1	19,602	6.0	142.9	4.0
Yellowfin goby	*Acanthogobius flavimanus*	12,025	2,894	184.1	2,805	325	26.4	14,830	4.5	210.5	5.9
Longfin smelt	*Sprinichus thaleichthys*	13,518	5,663	68.3	887	319	3.5	14,405	4.4	71.8	2.0
Sacramento splittail	*Pogonichthys macrolepidotus*	4,665	863	44.5	5,593	1,004	32.1	10,258	3.1	76.6	2.1
White catfish	*Ictalurus catus*	3,032	847	154.4	2,836	249	277.3	5,868	1.8	431.7	12.1
Other fish		9,776	979	131.9	8,974	577	388.4	18,750	5.7	520.3	14.6
Total		219,469		2,326.4	107,621		1,243.4	327,090		3,569.8	
Macroinvertebrates											
Pebble crab	*Rhithropanopeus harrisii*	128,003	12,934	204.8	87,070	4,664	106.5	215,073	67.2	311.3	68.1
Oriental shrimp	*Palaemon macrodactylus*	47,777	7,157	57.4	53,701	2,911	85.0	101,478	31.7	142.4	31.2
Bay shrimp	*Crangon franciscorum*	2,744	1,930	2.5	523	235	0.7	3,267	1.0	3.2	0.7
Other macroinvertebrates		12	8	–	54	20	–	66		–	
Total		178,536		264.7	141,348		192.2	319,884		456.9	

Source: PG&E 1981.

Note: There may be slight discrepancies in percentages that are due to rounding.

Table 6. Estimated numbers of selected fishes and macroinvertebrates impinged[(a)] at the CCPP under actual pump operation: May 1979 – January 1980.

Taxon		Units 1-5			Units 6&7			Total Units 1-7			
Common Name	**Scientific Name**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Standard Error**	**Weight (kg)**	**Number Impinged**	**Percent**	**Weight (kg)**	**Percent**
Fishes											
Striped bass	*Morone saxatilis*	470,066	27,686	4,129.2	51,229	9,741	375.6	521,295	77.5	4,504.8	61.2
Threadfin shad	*Dorosoma petenense*	55,755	6,444	401.9	21,231	2,433	103.1	76,986	11.4	505.0	6.9
Yellowfin goby	*Acanthogobius flavimanus*	23,631	1,973	445.6	2,543	390	40.7	26,174	3.9	486.3	6.6
American shad	*Alosa sapidissima*	19,123	1,772	118.9	790	287	7.2	19,913	3.0	126.1	1.7
Other fish		18,650	1,915	592.1	9,714	817	1,145.9	28,364	4.2	1,738.0	23.6
Total		587,225		5,687.7	85,507		1,672.5	672,732		7,360.2	
Macroinvertebrates											
Oriental shrimp	*Palaemon macrodactylus*	192,894	11,836	187.2	189,251	18,269	167.0	382,145	75.4	354.2	58.3
Pebble crab	*Rhithropanopeus harrisii*	100,391	10,130	212.8	1,193	498	32.9	101,584	20.1	245.7	40.4
Bay shrimp	*Crangon franciscorum*	3,931	1,613	3.8	18,806	1,111	1.0	22,737	4.5	4.8	0.8
Other macroinvertebrates		0			51	32	3.1	51	0	3.1	0.5
Total		297,216		403.8	209,301		204.0	506,517		607.8	

Source: PG&E 1981.

(a) Units 1-5 estimate includes estimated numbers returned to the River by the fish pump return system.

Note: There may be slight discrepancies in percentages that are due to rounding.

3.0 316(b) IMPINGEMENT MORTALITY STUDY

To characterize the impingement effects of the Contra Costa Power Plant's cooling water intake system (CWIS) on the source water aquatic resources, site-specific information will be collected on the composition and abundance of all fishes and macroinvertebrates that are impinged. This impingement study is designed to characterize lengths and weights of all impinged fishes, decapods, and shrimps. Estimates of annual impingement will be calculated for all these species. Presence/absence data will be recorded for colonial species such as bryozoans. An impact assessment of the most abundant and any listed fish and macroinvertebrates species will be provided in a final report.

3.1 Purpose and Design

Field data on the composition and abundance of impinged fishes and macroinvertebrates will provide an estimate of the total number and types of these organisms impinged on the intake screens of CCPP Units 6&7. These data, assuming 100% impingement mortality, will be used to estimate impingement losses. The study will include the following:

- taxonomic identification and enumeration of all lifestages of impinged fishes and shellfishes (including any species protected under Federal, State, or Tribal Law),
- characterization of the annual, seasonal and diel variations of impingement, and
- documentation of current impingement mortality to be used as calculation baseline.

The sampling program is designed to provide current estimates of the abundance, taxonomic composition, diel periodicity, and seasonality of organisms impinged at CCPP. In particular, the study will focus on the rates (i.e., number or biomass of organisms per m^3 water flowing per time into CCPP) at which various species of fishes and macroinvertebrates are impinged. The impingement rate is subject to tidal and seasonal influences that vary on several temporal scales (e.g., hourly, daily, and monthly), while the rate of cooling water flow varies with power plant operations and can change at any time.

A review of the previous impingement study at CCPP (see Section 2.0) provides background information on previous impingement effects. In addition, CDFG studies conducted in San Francisco Bay-Delta will provide information regarding the aquatic resources in the area of the power plant.

3.1.1. Sample Collection

Impingement sampling will be scheduled to occur over a 24-hour period one day per week if either Unit 6 or Unit 7 is generating (i.e., circulating water pumps are operating); no sampling will occur if generation is not needed from Units 6 and/or 7. Each sampling period will be divided into six 4-hour cycles. Before each weekly sampling effort, all of the screens will be rotated and washed clean of all impinged debris and organisms, and the operating status of each circulating water pump will be recorded on the data sheet. The sluiceways and collection baskets will be cleaned before the start of each sampling effort.

Samples will be collected by rotating and rinsing the impinged material from the Units 6&7 screens into a collection basket. The screens will remain stationary for a period of approximately 3.5 hours then they will be rotated and washed for 30 minutes. The impinged material from the traveling screens will be rinsed into the collection baskets made of mesh equal to or smaller than the 3/8-inch mesh of the intake screens. The debris and organisms rinsed will be processed according to the procedures presented in the following section. An example of the daily schedule of screen wash cycles and sample collection is provided in Table 7.

Occasionally, there may be such a large amount of debris collected on the traveling screens that the screens must be continuously rotated and rinsed. Sampling will be suspended during these times if the samples cannot be collected safely.

Table 7. Example of a 24-hour impingement sampling schedule for CCPP Units 6&7.

Time	Units 6&7
7:00	
7:30	Rinse and Clean
8:00	Start Cycle 1
8:30	
9:00	
9:30	
10:00	
10:30	
11:00	
11:30	Rinse Screens and Collect Cycle 1
12:00	Start Cycle 2
12:30	Process Cycle 1
13:00	
13:30	
14:00	
14:30	
15:00	
15:30	Rinse Screens and Collect Cycle 2
16:00	Start Cycle 3
16:30	Process Cycle 2
17:00	
17:30	
18:00	
18:30	
19:00	
19:30	Rinse Screens and Collect Cycle 3
20:00	Start Cycle 4
20:30	Process Cycle 3
21:00	
21:30	
22:00	
22:30	
23:00	
23:30	Rinse Screens and Collect Cycle 4
0:00	Start Cycle 5
0:30	Process Cycle 4
1:00	
1:30	
2:00	
2:30	
3:00	
3:30	Rinse Screens and Collect Cycle 5
4:00	Start Cycle 6
4:30	Process Cycle 5
5:00	
5:30	
6:00	
6:30	
7:00	
7:30	Rinse Screens and Collect Cycle 6
8:00	Process Cycle 6
8:30	
9:00	
9:30	
10:00	

Note: Schedule is separated into 30-minute increments to show activities associated with each cleaning and collection cycle.

3.1.2 Sample Processing

All fishes, crabs, and shrimps collected at the end of each 4-hour cycle will be identified and counted. Table 8 provides a summary of the data to be recorded for each of these taxonomic groups. Any mutilated organisms will be identified to the lowest taxonomic level possible, but their lengths and weights will not be recorded. If field personnel are unable to identify an organism, it will be preserved for identification in the laboratory.

Table 8. Summary of data to be recorded for organisms collected during the Contra Costa Power Plant impingement sampling.

Organism	Abundance	Length	Weight	Condition of Specimen
Chrondrichthys (sturgeons)	X	X	X	X
Osteichthys (bony fishes)	X	X	X	X
Decapod crabs	X	X	X	X
Shrimps	X	X	X	X

Note: - Length measurements will be made to the nearest 1.0 mm.
- Weight measurements will be made to the nearest 0.1 gram.
- Condition will be reported as alive, dead, mutilated, or fragmented.

The measuring criteria for selected organism groups are shown in Table 9.

Table 9. Measuring criteria for various groups of organisms that may be impinged at Contra Costa Power Plant Units 6&7.

Organism Group	Measuring Criteria*
Fishes	Total body length for fishes without forked tails and fork lengths for fishes with forked tails.
Crabs	Maximum carapace width
Shrimps	Carapace length, measured from the anterior margin of carapace between the eyes to the posterior margin of the carapace.

*Note: all measurements will be made to the nearest millimeter.

The wet body weight of individual animals will be determined after shaking loose water from the body. Total weight of all individuals combined will be determined in the same manner. All weights will be recorded to the nearest gram. The qualitative body condition of individual fishes and macroinvertebrates will be determined and recorded, using codes for decomposition and physical damage. Rare occurrences of other impinged animals, such as dead birds, will be recorded. The amount and type of debris (e.g., *Elodea* spp.) and any unusual operating conditions in the screen wash system will be noted by writing specific comments in the "Notes" section of the data sheet.

Two measurement procedures will be used, depending on the number of individuals of a given target species present in the sample. If the number of individuals per species in the sample or subsample is 30 or less, the linear measurement, weight, and body condition codes for each individual will be determined and recorded. If the of individuals per species is greater than 30 the following criteria apply:

1. The linear measurement, individual weight, and body condition codes for a subsample of 30 individuals will be recorded on individual lines of the data sheet. The individuals chosen for measurement will be selected after spreading out all of the individuals in a sorting container, making sure that they are well mixed and not segregated into size groups. Fragments of organisms will be eliminated from consideration since linear measurements would not be representative.

2. The total number and total weight of all the remaining individuals combined will be determined and recorded on a separate line.

The total weight of all impinged detritus will also be recorded during each collection effort either directly or through subsampling if there is a large amount of debris. In addition to data on impinged material, the operating status of the circulating water pumps, data on tide, weather, and sea state conditions will be recorded on the data sheets for each cycle.

3.1.3 Data Processing and Impact Assessment

Impingement estimates for species and taxonomic groups will be obtained by first calculating the cooling water flow during each screen wash cycle sampled during the 24-hour survey. The total time for each screen wash cycle will be multiplied by the flow rate for Units 6&7. The flow rate for each screen wash cycle will be used in calculating an impingement rate based on the total number of organisms for a species or taxonomic group collected during the cycle.

Sub-sampling will be used to contend with any large influx of a single taxon. If a large number (greater than 30) of individuals from a single taxon are collected during a cycle, 30 individuals will be measured and weighed while the remainder will be counted and batch-weighed. For these taxa, weights and counts for the measured individuals will be totaled and then an average weight per individual will be calculated. This unit weight per individual will be multiplied by the total count (including the individuals that are not weighed) to obtain an estimate of the total weight for each cycle. The average impingement rate and its associated variance for the 24-hour collection period will be calculated from the rates (number and weight) calculated for the screen wash cycles.

The average impingement rates (number and weight) for each taxon over the 24-hour collection period will be used to obtain estimates of impingement for the entire weekly survey period. The days between impingement collections will be assigned to each weekly survey period by using the collection day as the median day within the period and assigning the days on either side of that collection date to create a weekly survey period. In most cases, the weekly survey periods will be 7 days, but when weekly surveys cannot be conducted, the periods will be longer. The total flow for the days within each survey period will be calculated using records of pump operation at the power plant and multiplied by the average impingement rates if actual impingement is being calculated. If impingement under baseline conditions is being calculated, the impingement rates would be multiplied by design flows totaled for the weekly survey period. Occasionally, the only individuals collected for a taxon during an impingement survey may be mutilated and therefore no biomass estimates will be available for those surveys. Finally, the total biomass and abundance estimates for each study period will be summed to obtain annual estimates for each taxon.

3.1.4 Quality Assurance and Quality Control Program

A Quality Assurance/Quality Control Program will be implemented throughout the year-long study. Impingement cycles will be randomly chosen for onsite QC re-sort to verify that all the organisms were removed from the impinged material. Organisms from randomly chosen cycles will be checked to ensure the correct identification, number, and length and weight measurements were recorded on the data sheet. Field data sheets will be checked against the database to ensure that data were entered accurately.

3.1.5 Reporting

A final Impingement Mortality Report will be submitted after all analyses are completed. The report will contain life history summaries of the most abundantly impinged fishes and macroinvertebrates and present the value of any commercial harvested impinged species based on reported market price. Impingement of any threatened or endangered species will also be discussed. Impingement source water impacts will be evaluated using various CDFG study data and presented in the report.

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Clean Water Act Section 316(b)
Proposal for Information Collection for Mirant’s Contra Power Plant

Submitted In Compliance with 316(b) Regulatory Requirements for Cooling Water Intake Structures at Phase II Existing Facilities

Appendix B

Use of Restoration Measures

APPENDIX B

Under the final Clean Water Act 316(b) Phase II rule (40 CFR § 122 et seq.; 69 Fed. Reg. 41576, July 9, 2004) (Phase II Rule), applicants may use restoration measures in addition to, or in lieu of, technology measures to meet performance standards or in establishing best technology available (BTA) on a site-specific basis. Specifically, EPA's Phase II Rule states the following requirement relative to the use of the restoration approach:

*Facilities that propose to use restoration measures must demonstrate to the permitting authority that they evaluated the use of design and construction technologies and operational measures and determined that the use of restoration measures is appropriate because meeting the applicable performance standards or requirements through the use of other technologies is less feasible, less cost-effective, <u>or</u> less environmentally desirable than meeting the standards in whole or in part through the use of restoration measures***.** 69 Fed. Reg. 41609 [emphasis added].

As discussed in Section 3.0 of the PIC, Mirant will work with the resource agencies such as U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), Regional Water Quality Control Board (Water Board), and California Coastal Commission (CCC) to identify potential programs. Mirant will then evaluate various potential technology and operational measures that could be implemented to comply with the Phase II Rule's performance standards. Mirant will also examine restoration options to determine whether they would be more feasible, cost-effective, or environmentally desirable than technology or operational measures.

Types of Restoration Applicable to §316(b)

The Phase II Rule does not specify the types of restoration measures that can be used. This lack of specification provides flexibility in developing/proposing a restoration approach. Restoration measures that have been used at other power plants to meet §316(b) requirements under state regulatory programs include:

- Wetland restoration (e.g., Public Service Electric & Gas (PSEG) Delaware Bay wetland restoration program for the Salem Generating Station) (Weinstein et al. 2001);
- Fish stocking (e.g., Mirant Mid-Atlantic fish hatchery at the Chalk Point Station (Bailey et al. 2000); Exelon's (formally Commonwealth Edison) walleye hatchery at Quad Cities Station on upper Mississippi River (LaJeone and Monzingo 2000); and Southern California Edison's (SCE) white seabass hatchery (CDFG 2002);
- Submerged aquatic vegetation restoration (e.g., SCE's kelp restoration for the San Onofre Nuclear Generating Station (SONGS) (Deysher et al. 2002);

- Fish passage measures (e.g., fish ladders or dam removal) at non-hydropower projects (e.g., PSEG fish ladders in Delaware Bay tributaries for the Salem Generating Station) (EPRI 2003);
- Preservation/restoration funding (e.g., contribution to, or maintenance of, a fund to be used for marsh restoration, preservation, and conservation, and watershed land acquisition related to impacts associated with the re-powering of the Moss Landing Power Plant near Elkhorn Slough (Monterey Bay, California) – see http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/reports/; and
- Water quality improvements (e.g., riparian area protection or implementation of non-point source best management practices) that minimize sediment/pollutant runoff thereby resulting in fishery habitat improvements, and practices that increase dissolved oxygen content in waterbodies thereby increasing available habitat for fish spawning and survival. These water quality improvements have not yet been conducted as part of a 316(a) or 316(b) restoration project.

Potential Restoration Measures for Mirant's Contra Costa Plant

Mirant may wish to consider the following sample restoration projects[1] to attain the impingement mortality reduction performance standard or as part of a site-specific standard if Compliance Alternative 5 is selected.

Mirant's program might include restoration alternatives such as:

- Fish Stocking: co-funding a fish hatchery program intended as supplementary mitigation for fish impacts;
- Habitat Protection: participation in habitat protection or restoration programs; or
- Alternative Measures: consideration of water quality improvement measures.

Some examples under these categories are discussed in more detail below. The following projects are listed because of their known interest to resource agencies in California and because design and implementation information is readily available:

<u>Fish stocking</u> – While forage species (e.g., gobies, anchovies, sardines) are the most common species impacted at California power plants, stocking of these species to compensate for the losses would likely not be of interest to any of the federal and state fish and wildlife agencies. The objective of a supplementation program would be to identify a "species of concern," the stocking of which would compensate ("comparable to, or substantially similar to") for the

[1] Projects listed are examples – opportunities for creative restoration projects are unlimited and depend upon corporate interests and negotiations with state and federal resource agencies. Mirant also owns 139-acre site (referred to as the Montezuma Enhancement Site) that is located between the Pittsburg and Contra Costa power plants near Collinsville, California. Mirant is having discussions with the resource agencies to develop a preservation plan for this site, and may consider restoration measures.

production foregone as measured by a game fish's consumption (e.g., X northern anchovy are equivalent in energy or food consumption to Y white seabass or other recreational or commercial fishes of concern). This is the approach used by the Potomac Electric Power Company for estimating annual hatchery production of striped bass to compensate for bay anchovy (a forage species) losses at their Chalk Point Generating Station on the Patuxent River in Maryland, discussed further below.

A fish stocking program, particularly for the steelhead or salmon (both of which are federal and state listed endangered and threatened species) may be of interest in California. Such a fish stocking program could be via hatchery operation developed on or off plant property (e.g., SCE funds the operation of a fish hatchery in Carlsbad, CA for culturing and stocking white seabass, discussed below). Such a hatchery would be operated and maintained under state and federal oversight. Alternatively, Mirant could possibly negotiate a direct annual contribution of funds to a state and federal hatchery supplementation program or a private foundation. For example, CDFG and NMFS have a long-term fish hatchery program to support maintenance and restoration of anadromous salmonids in California coastal rivers (CDFG/NMFS 2001). California resource agencies' experience with hatchery supplementation may mean that they could be receptive to a hatchery program established by Mirant as compensation for impingement losses.

Examples of fish stocking projects include:

- *Georgia Department of Natural Resources (GDNR) re-stocking project* – following six years of study, GDNR recently initiated a long-term effort to restore lake sturgeon to the Coosa River system in Georgia/Alabama. This species is listed as threatened throughout the U.S. and has disappeared completely from much of its original range, including the Coosa River. Through a collaborative effort between several state and federal agencies, GDNR released 1,100 fingerlings to the Coosa River in December 2002 as the first step towards returning lake sturgeon to a healthy, self-sustained population in the river. See: http://georgiawildlife.dnr.state.ga.us/content/displaycontent.asp?txtDocument=305).

- *Mirant Mid-Atlantic Inc. re-stocking program* – Mirant currently raises and stocks Atlantic sturgeon at its Chalk Point Hatchery Facility on the Patuxent River for the State of Maryland, Department of Environmental Protection. American shad restoration to the Susquehanna River basin in Maryland/Pennsylvania has been accomplished in part via stocking of juvenile shad and via provision of fish passage (St. Pierre 2003; Hendricks 1995). Restoration stocking (e.g., for steelhead) could also be combined with provision of fish passage (i.e., dam removal or fish ladders). This form of restoration is discussed further below.

- *SCE fish hatchery project* – the Hubbs/Sea World Research Institute operates the SCE fish hatchery as one aspect of its SONGS mitigation. When operating at design capacity, the SCE funded hatchery is expected to exceed compensation for the total SONGS fish losses estimated by an expert panel created by the CCC. For approximate cost references, SCE provided $4.7 million in funding for the white seabass hatchery, which began operation in late 1996. See: http://www.sce.com/sc3/006_about_sce/006b_generation/006b1_songs/006b1c_env_prot/006b1c3_songs_miti/default.htm)
- *Potomac Electric Power Company (PEPCO) aquaculture facility* – similar to the SONGS mitigation, PEPCO established an aquaculture facility at their Chalk Point Station in Maryland at a capital cost of $1 million in 1990. Annual operating costs have been approximately $175,000 to $250,000 depending on the species and number of organisms raised and stocked in Maryland waters. See:

  http://www.sce.com/sc3/006_about_sce/006b_generation/006b1_songs/006b1c_env_prot/006b1c3_songs_miti/default.htm).

Habitat Protection– The importance of wetlands, in-stream habitat, and riparian areas as aquatic habitat for fishes and invertebrates, and as habitat for wildlife is reviewed in EPRI (2003). Wetland restoration or habitat restoration in general, is becoming increasingly popular across the U.S. and there is a growing case history with use of habitat restoration as a 316(b) mitigation approach (EPRI 2003). In California, over 90% of its historic wetlands and 95% of historic streamside trees, shrubs, and ground vegetation has been lost from urbanization, agricultural conversion, logging, and flood control (USFWS 2001). Habitat restoration, therefore, should be a major interest to federal and state resource agencies and non-governmental organizations in California. The following identifies federal, state, and private restoration programs that provide information that Mirant may find of value for establishing its own restoration program or offer opportunities to collaborate on potential restoration projects.

Examples of habitat protection projects include:

- *Kimball Island Mitigation Bank* – Riparian, riverine, tidal, and marsh habitat development and restoration. This project complements local, state, and federal efforts to restore ecological integrity to the Delta and enhance the sustainable production and survival of native and other desirable fish and wildlife species, including: delta smelt, steelhead, Sacramento splittail, Chinook salmon, California black rail, Delta tule pea, Mason's lilaeopsis. See:

  http://www.wildlandsinc.com/kimball.htm

- *Dutch Slough Tidal Marsh Restoration* – The Dutch Slough project is a 1,200 acre tidal marsh restoration project in the Sacramento-San Joaquin Delta near Oakley, California.

The land, originally slated for development of 4,500 homes, was purchased by CALFED and the State Coastal Conservancy. Collaborative effort between California Department of Water Resources, the California Bay Delta Authority, the California State Coastal Conservancy, and the City of Oakley. Habitat restoration may benefit delta smelt. See: http://www.dutchslough.org/project_description.html

- *Various CalTrans Bridge Expansion Projects – Skaggs Island*: CalTrans will provide up to $8.5 million to remove infrastructure from the Navy's former administrative site on Skaggs Island. With this assurance, USFWS will accept the long-anticipated interagency transfer of the Island from the Navy. Once the Navy buildings are removed, USFWS can begin planning and implementing wetland restoration on the entire 3,300 acres. *Martinez Regional Shoreline Park:* an 11-acre marsh enhancement and flood management project at the Martinez Regional Shoreline Park in the City of Martinez, Contra Costa County. The project provided mitigation credit for impacts related to a number of Caltrans projects. The project integrates flood control, delta smelt habitat creation, and marsh enhancement goals with the opportunities and constraints of the site. *Eastshore Regional Shoreline:* CalTrans will fund East Bay Regional Park District for shoreline and tidal marsh restoration project at the Eastshore Park. See: http://biomitigation.org/bio_overview/permits_mous.asp

- *Coastal Conservancy, USFWS, and CDFG's South San Francisco Bay Salt Pond Restoration Planning* – The Coastal Conservancy, USFWS, and CDFG are working with others to plan the restoration of 15,100 acres of commercial salt ponds located in South San Francisco Bay. The project is to restore the existing ponds to a mix of tidal marsh, mudflat, and other wetland habitats. See: http://www.coastalconservancy.ca.gov/sccbb/0509bb/0509Board11a_South_Bay_Salt_Pond_Restoration.pdf

- *Save the Bay, San Francisco State University, University of Washington, NMFS, and* other *organization's* Eelgrass Restoration Project – The eelgrass seed dispersal project builds on methods used successfully on the Atlantic Coast. The dispersal process begins with the collection of flowering shoots from donor sites (Pt. San Pablo, Crown Beach, and others). The shoots are placed in mesh bags, which are then hung from buoys at restoration sites (China Camp, Marin Rod and Gun Club, and others).

- *San Francisco Bay Area Conservancy Programs* – The Bay Area Conservancy helps public agencies and private nonprofit organizations preserve open space, protect and restore fish and wildlife habitat, promote the use of habitat restoration projects for environmental education, provide public access to open space areas, and restore urban waterfronts in the nine Bay Area counties. One of the projects, the San Francisquito Creek Watershed Steelhead Recovery project, will modify fish barriers and remove invasive aquatic plants to restore steelhead passage. See:
  http://www.coastalconservancy.ca.gov/Bay%20Program/annualreports/11.04report.pdf
- *Duke Energy's Morro Bay Modernization Project Habitat Enhancement Program* – as part of the station modernization, Duke Energy has volunteered to fund a program that would reduce sedimentation and the other major factors undermining the Bay's productivity. The concerns for Morro Bay and the target of Duke's proposal are the issues identified by the Morro Bay National Estuary Program's (MBNEP) Comprehensive Conservation Management Plan (CCMP). Those issues include sedimentation, loss of habitat, and nutrient pollution. Duke's proposal is their preferred alternative to dry cooling operation. The Central Coast Regional Water Quality Control Board (CC Water Board) staff agreed with Duke's proposal finding that habitat enhancement would yield greater long-term benefits for the Bay. Duke Energy's proposal would fund habitat enhancement projects authorized by the CC Water Board and managed through professional groups like the MBNEP, which have plans and programs to reduce sedimentation and other factors undermining the Bay's productivity. The special value of habitat enhancement is that it not only addresses marine biology, but also protects and enhances habitat for birds and other animals and sustains important recreational resources for the community. Documents describing the program in detail can be downloaded from the noted website. Because of recent economic conditions across the U.S., Duke has canceled plans for modernizing the Morro Bay Power Plant and, as a result, their habitat enhancement project has not been implemented. See:
  http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/reports/)

- *SCE's SONGS Mitigation* – The SONGS mitigation includes a multi-faceted environmental enhancement program intended to mitigate unavoidable impacts to the marine environment resulting from operation of the SONGS Units 2&3 cooling water systems. In addition to the fish hatchery discussed above, it includes restoration of San Dieguito Lagoon and creation of an offshore artificial reef. The California resource agencies and local non-governmental organizations will likely heavily rely on lessons learned during the negotiation and development of the SONGS Program. See:

  http://www.sce.com/sc3/006_about_sce/006b_generation/006b1_songs/006b1c_env_prot/006b1c3_songs_miti/default.htm)

- *PSEG's Delaware Bay Estuary Enhancement Program* – This is the largest restoration program the U.S. implemented as compensation for impingement and entrainment losses at a power station. Established in 1995, this program was negotiated with New Jersey Department of Environmental Protection as a mitigative action for fish losses at the Salem Nuclear Generating Station in lieu of implementing a closed-cycle cooling system. Principally focused on the restoration of approximately 10,000 acres of former salt hay farms to natural estuarine salt marsh in the lower Delaware Estuary, the program also includes provision of fish passage in combination with some limited fish stocking to support restoration of anadromous (American shad and river herring) fish stocks. Details of the program can be found in Weinstein et al. (2001). In a following section, the method used by PSEG to scale (i.e., convert fish loss to acres of equivalent wetland habitat) the size of the requisite restoration project is demonstrated. The PSEG incurred costs to date for the ongoing restoration project, including capital, operation and maintenance, and monitoring exceed $100 million or $9,350/acre (EPRI 2003).

- *Santa Monica Bay Restoration Commission* – In recognition of the need to restore and protect the Santa Monica Bay and its resources, the State of California and the U.S. Environmental Protection Agency established the Santa Monica Bay Restoration Project (SMBRP) as a National Estuary Program in December of 1988. The Project was formed to develop a plan that would ensure the long-term health of the 266 square mile Bay and its 400 square mile watershed, located in the second most populous region in the United States. That plan, known as the Santa Monica Bay Restoration Plan, won State and Federal approval in 1995. Since then, the SMBRP's primary mission has been to facilitate and oversee the implementation of the Plan. The SMBRP identifies almost 250 actions, including 74 priority actions, that address critical problems such as storm water and urban runoff pollution, habitat loss and degradation, and public health risks associated with seafood consumption and swimming near storm drain outlets. The SMBRP outlines specific programs to address the environmental problems facing the Bay and identifies implementers, timelines, and funding needs. On January 1st, 2003, the SMBRP formally became an independent state organization and is now known as the Santa Monica Bay Restoration Commission (SMBRC). The SMBRC continues to carry out restoration efforts based on the SMBRP. See:

http://www.santamonicabay.org/site/aboutus/layout/index.jsp

- *National Oceanic and Atmospheric Administration (NOAA) Community-based Restoration Program (CRP)* – This program applies a grass-roots approach to restoration by actively engaging communities in on-the-ground restoration of fishery habitats around the nation. The CRP emphasizes partnerships and collaborative strategies built around restoring NOAA trust resources and improving the environmental quality of local communities. The program is: (1) providing seed money and technical expertise to help communities restore degraded fishery habitats, (2) developing partnerships to accomplish sound coastal restoration projects, and (3) leveraging resources through national, regional, and local partnerships. This program is one of the services of the NOAA Restoration Center. This Center's mission is to enhance living marine resources to benefit the nation's fisheries by restoring their habitat. Working with others, the Center achieves its mission by (1) restoring degraded habitats, (2) advancing the science of coastal habitat restoration, (3) transferring restoration technology to the private sector, the public, and other government agencies, and (4) fostering habitat stewardship and a conservation ethic. Recently, under the community-based program, NOAA awarded $250,000 to the Gulf of Mexico Foundation for habitat restoration in the five states bordering the Gulf of Mexico. EPA, under their Gulf of Mexico Program (see following) similarly awarded $90,000 to the Foundation. These awards launched a major new effort to reclaim essential fish habitats of the Gulf of Mexico by implementing field efforts to restore and improve marine and coastal habitats that have been degraded or lost. See:

  http://www.nmfs.noaa.gov/habitat/restoration

- *USFWS Partnership for Fish & Wildlife* – This program is supported by funds from federal and state agencies, private landowners, and non-governmental organizations (e.g., Ducks Unlimited, CDFG, The Nature Conservancy). The program is a voluntary partnership program with a goal to restore wetlands and other vital habitats on private land with 70% of the current funding coming from private sources. The remaining funds, along with restoration design and technical assistance is provided by USFWS. State resource agencies, such as CDFG, work with USFWS to help establish priorities and identify focus areas. The restoration of degraded wetlands, native grasslands, streams, riparian areas, and other habitat to conditions as close as possible to natural is emphasized. The Partnership for Fish and Wildlife Program is important for restoration of critical habitats in California (USFWS 2001). Mirant's financial support to the

program and potential in-kind service could potentially be negotiated as compensation for impingement mortality losses at CCPP. See:
http://partners.fws.gov/index.htm)

- *Coastal America's Corporate Wetland's Restoration Partnership (CWRP)* – CWRP is a program designed to foster collaboration between the federal government, state agencies, and private corporations. Private corporations that participate in this national program will donate funds for either site-specific wetland or other aquatic habitat restoration projects or provide matching funds to a national or regional effort in support of aquatic ecosystem restoration activities. Projects that will receive funds from the CWRP will all be approved Coastal America projects while federal agencies will assist in their proper execution. The Coastal America Partnership will coordinate among all of its Regional Implementation Teams to identify the appropriate private foundation or state trust fund that will receive funds from the CWRP. This organization will not likely accept support in response to regulatory requirements. However, the organization is a source of wetland restoration information and unique partnerships may be arranged. See:
  http://www.coastalamerica.gov/text/cwrpoperating.html

<u>Alternative Restoration Measures</u> – the above measures have been identified as the most likely restoration approaches that would be receptive to the Water Board and other federal and state resource agencies. Other potential approaches include non-point source pollutant runoff abatement programs and contaminated sediments restoration. While these types of efforts focus on water quality improvements, the long-term benefit is improved fish and shellfish habitat. Such efforts would have to demonstrate a clear linkage between the two as compensation for impingement losses at CCPP. The CCC is implementing a statewide Non-point Source Program. Elements of the plan include management measures for reducing runoff pollution from agriculture, silviculture, urban areas, marinas and recreational boating, and via hydromodification (includes modification of stream and river channels, dams and water impoundments, and streambank/shoreline erosion). CCC, therefore, is a source of information for developing a potential non-point source runoff abatement program or implementing best management practices (BMPs) to meet the goals of the State's plan in the San Francisco Bay Area. See:
http://www.coastal.ca.gov/nps/npsndx.html.

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Appendix C

Deriving Economic Benefits of Reduced Impingement and Entrainment at Mirant’s Contra Costa Power Plant

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1.0 BACKGROUND

For use of the Cost-Benefit test under the site-specific standards, Mirant is required to prepare a Benefits Valuation Study. EPA's 316(b) Phase II Rule (40 CFR § 122 et seq.; 69 Fed. Reg. 41576, July 9, 2004) (the Phase II Rule) requires the use of a comprehensive methodology that will value fully the impacts of impingement mortality[1] at the Contra Costa Power Plant (CCPP). Specifically, the Phase II Rule requires:

- A description of the methodology(ies) used to value commercial, recreational, and ecological benefits (including non-use benefits, if applicable);
- Documentation of the basis for any assumptions and quantitative estimates;
- An analysis of the effects of significant sources of uncertainty on the results of the study;
- If requested by the NPDES permitting authority, a peer review of the items you submit in the Benefits Valuation Study;
- A narrative description of any non-monetized benefits that would be realized if the applicable performance standards were met and a qualitative assessment of their magnitude and significance.

In sum, the Phase II Rule provides that all benefits, whether expressed qualitatively or quantitatively, should be addressed in the Benefits Valuation Study in determining whether compliance costs significantly exceed benefits.

Based on the information generated by the impingement mortality studies, the benefits assessment would include a qualitative and/or quantitative description of the benefits that would be achieved by compliance with the applicable performance standards at the facility site. To the extent feasible, dollar estimates of all significant benefits categories would be made using well-established and generally accepted valuation methodologies.

[1] As discussed in Sections 2.0 and 3.0 of the PIC, Mirant anticipates that capacity utilization will not exceed 15% for the 5 years preceding the submittal of the CDS. In the event capacity utilization exceeds 15%, Mirant plans to demonstrate compliance with the entrainment performance standard under Compliance Alternative 2. Consequently, Mirant does not plan to evaluate site-specific compliance alternatives for entrainment reduction at this time.

2.0 DESCRIPTION OF METHODOLOGIES TO DETERMINE BENEFITS

The Phase II Rule defines performance standards that the EPA has established for all existing power plant facilities. The Phase II Rule provides that facilities can implement site-specific "best technology available" measures if it can be shown that the costs of achieving the performance standard are significantly greater than the benefits. Therefore, Mirant is providing a plan to collect information in the event that it is necessary to determine whether the benefits of the identified technology are significantly less than costs.

The overall approach for the benefits analysis will be based on the methods used in EPA's national analysis of benefits. Deviations from EPA's approach will be to use site-specific data and information as appropriate. The process used for the cost-benefit analysis will be consistent with that outlined in the preamble of the Phase II Rule. 69 Fed. Reg. at 41647-48. The key steps for producing a quantitative benefit estimate are (1) identification of key species to include in the analysis based on forthcoming impingement data; (2) quantification of direct use recreational and commercial fishing benefits; and (3) determination of the need for non-use benefit quantification based on the results of the impingement mortality studies.

2.1 Benefits Assessment Based on Impingement Study

Impingement studies were conducted in 1978–1979 and again for part of the year from 1987 through 1990. Due to the age of those studies, new impingement studies are proposed as described in Appendix A of the PIC. For juvenile impinged fishes and shellfish, the EPA approach of converting these losses to quantifiable economic metrics will be used. The metric used for commercial and recreational harvested species will be equivalent adult losses. The metric for non-harvested species will be production foregone. This metric is based on the assumption that non-harvested species are consumed by harvested species to allow an economic value to be assigned to losses of these species. The approach will follow EPA's method of selecting the dominant species for inclusion in the analysis and appropriate predator species for the quantification of equivalent adult losses. The existing study information indicates that striped bass and threadfin shad are the species most likely to be impinged. The species chosen will be based on the final impingement mortality study, which will indicate the species that are directly or indirectly (through forage fish changes) affected. For now, we consider the typical recreational and commercial species that are caught in and around the San Francisco Bay-Delta, and particularly in the estuarine reach of the San Joaquin River. When better information is available, more specification will be possible. Because delta smelt and Chinook salmon could conceivably be affected, non-use values of those species will be addressed below.

2.2 Valuation of Recreational and Commercial Fishery Use Benefits

In determining benefits at a national level, EPA used certain economic concepts of benefits associated with using the assets that cooling water adversely affects and methodologies to estimate the benefits (USEPA 2004a, b, c). In order to make the benefits comparable to costs, they presented benefits in a monetary unit—dollars. This benefit analysis will seek to provide a unit value per fish caught ($/fish) for recreational and commercial species affected by the new technology. With this information, total recreational and commercial benefits can be determined by multiplying the unit value by the expected increase in recreational and commercial catch arising from the identified technology.

2.2.1 Recreational Angling

For recreational angling, there are two potential valuation approaches:

1. Benefit Transfer—the application of benefit estimates provided in other studies to the CCPP situation;

2. Collection of Site-Specific Data—collection and/or assemblage of data on recreational fishing on the San Francisco Bay-Delta including the estuarine reach of the San Joaquin River and use of the data to derive an estimate of the value per fish for the important species.

While the two approaches initially will be discussed independently, there is a sound reason to consider them in concert with one another. That is, the benefit transfer information provides a reality check for any values derived in the primary research. Any site- specific research effort should contain a thorough literature review, a component that would have information very similar in nature to the benefits transfer analysis. Also, the benefit transfer approach may provide a fallback position if the primary research is unsuccessful in providing benefit estimates. After both have been discussed independently, a strategy that integrates them is discussed in Section 2.2.1.2.

Recreationally harvested species that occur in CCPP source water include catfish, bluegill, and black crappie, which are typically found in lower salinity estuarine conditions, and striped bass and white sturgeon, which migrate past the power plant. All of these species have been entrained and/or impinged during the 1978–1979 316(b) studies.

2.2.1.1 Valuation Approaches

Benefit Transfer

The use of benefit transfers requires identifying a previous economic study (or studies) that considers a comparable situation to fishing near CCPP and contains dollar values per unit fish caught or a value function for dollar values per unit fish caught. Although there are numerous variables in benefit transfer valuations, particularly important is the identification in previous economic studies of those species similar to the affected species and a fishing population similar to the local fishing population.

In order to identify an appropriate study or studies, it would be essential to visit the site to examine first-hand the type of recreational fishing that is occurring. At the same time, contact with key people in the area will be made to determine if any relevant studies or data do exist (see references for some articles). It would be important that the following sources be contacted or examined:

1. State or Federal hearings on previous CCPP permit renewal.

2. State or Federal hearings on previous power plant facilities in the San Francisco Bay-Delta area.

3. Personnel assigned to the Interagency Ecological Program (IEP).

4. Authors of EPA "in-house" studies associated with the Phase II Rule. In particular, EPA's RUM analysis of the California region (USEPA 2004d) should be considered.

5. Personnel from California Fish and Game. Also, the National Marine Fisheries Service employs Drs. Dale Squires, Cynthia Thompson and Sam Herrick, who are experts in fisheries economics and management.

6. Researchers at universities or other research facilities:
    a. University of California, Berkeley

        Dr. Michael Hanneman (Department of Agricultural and Resource Economics) is an expert in economic valuation and has studied sportfishing in California;

    b. University of California, San Diego

        Dr. Richard Carson (Department of Economics) is an expert in contingent valuation and non-use valuation;

    c. University of California, Los Angeles

        Dr. Trudy Cameron is an expert in econometrics and has studied sportfishing in California;

   d. Local Consulting firms. Jones and Stokes Inc. (particularly Thomas Wegge) of Sacramento completed numerous sportfishing studies in California.

7. Existing bibliography sources available by internet:

   a. National Marine Fisheries Service, Southeast Fisheries Center,
   b. Sportfishing Values Database,
   c. Environmental Valuation Reference Inventory (EVRI): Canadian based,
   d. Beneficial Use Values Database (BUVD),
   e. Regulatory Economic Analysis Inventory, (REAI) maintained by EPA,
   f. ENVALUE, an environmental value database maintained in Australia.

8. *Investigation and Valuation of Fish Kills* (American Fisheries Society [AFS] 1992). Excerpt: "Chapter 4 ("Monetary and Economic Valuation of Fish Kills") dates back to the Pollution Committee's *Monetary Values of Fish* booklets of 1970 and 1975, which dealt with southern U.S. species. In 1978, the AFS North Central Division's Monetary Values of Fish Committee published *Reimbursement Values for Fish,* addressing species in 12 northern states and 2 Canadian provinces. To integrate these and other regional values, a special AFS Monetary Values of Freshwater Fish Committee collected values from 135 federal, state, provincial, and private agencies and hatcheries. These data were published in 1982 as Part I of AFS Special Publication 13. For the present book, the Socioeconomics Section has repeated the earlier survey to update replacement costs for killed fish and summarized procedures for estimating the broader economic losses resulting from a fish kill."

These potential sources will be used to obtain "off-the-shelf" values that could possibly be relevant to the affected species at the CCPP. In addition, some of these contacts may be useful as researchers, data sources, and/or witnesses for any hearings that may occur. They may also be useful as peer reviewers or as sources to identify peer reviewers.

Collection of Site Specific Data

There are several other methodologies that could be used to estimate economic values for the species considered, but they will require some level of analysis and may require additional data collection.

Data and programs could be obtained from the EPA to examine whether the results reported in EPA (2004d) are defensible. If they are not, a new RUM model could be estimated with the data. The major changes that should be examined by the research are:

1.) correcting (if necessary) problems associated with the original analysis;
2.) grouping the key species into their own group rather than in a general grouping;
3.) including the effect of sportfish consumption warnings in San Francisco Bay-Delta and other California areas; [2]
4.) developing the welfare estimates for San Francisco Bay-Delta sites rather than using an average over all sites used in the EPA study.

The analysis would also update the angling activity information and possibly generalize the RUM model in ways that current literature is leading.

2.2.1.2 Integration of Approaches

The two approaches discussed above can be integrated as follows. The initial portion of the study would be to complete a benefits transfer analysis and determine whether or not the values obtained were reasonable for the purposes of the decisions to be made. That is, if the mitigation strategy returned recreational benefits that were approximately equal to the costs, it may be unwise and inefficient to collect site-specific data because in all likelihood the estimate of costs would not be "significantly larger" than the benefits. If however, the benefit transfer method suggested that the benefits were to be small relative to costs, it may or may not be useful to pursue one of the primary research plans suggested in the previous section. The quality of existing studies would also be a prime determinant.

Discussions with experts in the benefit transfer research community would determine the availability and reliability of data from the previous studies of recreational fishing. In addition, some notion of the potential improvement in estimates from using new data and a new model would be obtained.

With this information and a better understanding on the costs of doing the site-specific analysis, decisions regarding what combination of benefit transfer and site-specific analysis would be facilitated. The site-specific analysis would in all likelihood provide better estimates of value but may be more costly. Given the present information, it is likely that the analysis performed

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[2] One of the major problems in San Francisco Bay-Delta is the potential for harvest of contaminated fish. California issues sportfish consumption warnings and it will be necessary to consider the effect of sportfish consumption advisories on the value of recreational fish. This was not done in the EPA study (USEPA 2004d). More recently, the California Department of Fish and Game (http://www.dfg.ca.gov/ mrd/fishcon1.html) advised anglers to limit consumption of sportfish caught in San Francisco Bay-Delta to two fish per month. The literature suggests that unit values are smaller when water quality is so low that states must advise anglers against the consumption of sportfish (Jakus et al. 1997). Thus, the EPA model will likely have to be changed to introduce the potential for seafood consumption warnings on species, site, and mode choices.

by EPA in 2004 could be augmented, and improved sufficiently to provide reliable recreational unit values per fish caught.

2.2.2 Commercial Fishing

The first determination in the valuation of commercial fishing benefits would be whether commercial fishing is affected by reduced mortality to affected species and what percentage, if any, the improved commercial harvest would represent of the total improved harvest. California Department of Fish and Game and the National Marine Fisheries Service would be consulted regarding species that the impingement studies identified.

Both producers and consumers could gain from increases in commercial catch, but the assessment would likely only estimate the gains to direct producers, i.e., commercial fishermen. This is based on the expectation that relatively small changes in commercial landings result from reduced impingement and entrainment mortalities. This is the approach that EPA took in the 2004 study (USEPA 2004e).

The approach that EPA uses for assessing commercial benefits to producers bases the unit value on the ex-vessel price (sometimes referred to as dockside price) of the species under consideration. The logic of the approach begins with an assumption that harvest increases do not induce effort (inputs used in harvesting) to increase in the short-run after the reductions of impinged organisms. If this were entirely true, then the ex-vessel price multiplied by the increase in quantity harvested would represent producers' surplus. However, EPA appreciates that this would not likely be true and that effort and costs would undoubtedly increase in the long run in response to increased commercial profits (i.e., producer surplus). In the absence of property rights to the harvest, one would expect the producer surplus to be eliminated. Recognizing this and allowing for uncertainty in effort response, the EPA proposes using a range of 0–40 percent of the ex-vessel price multiplied by the increase in harvest as a measure of the increase in producers' surplus.

Commercially harvested species that occur in CCPP source water include starry flounder, which are typically coastal and baywide in their occurrence, and salmon, an anadromous species, which migrate past the power plant. Starry flounder were impinged and entrained during the CCPP 1978–1979 316(b) studies–this species is covered under the groundfish Fishery Management Plan and has designated Essential Fish Habitat. Low numbers of adult and juvenile salmon were impinged during the 1978–1979 316(b) studies, and even fewer salmon were entrained since the species early freshwater life stages are occur far inland of the CCPP source water. Fisheries information on source water salmon is available through a variety of federal and state management plans, including the endangered species recovery plan for seasonally designated races of salmon that migrate past the CCPP. Additional economic information on groundfish may be available through the fisheries management groups. These plans may contain information that would permit an analysis that is an improvement to the EPA approach.

In the unlikely event that the change in landings would be relatively large and cause a change in commercial salmon and starry flounder prices, information on commercial harvests and prices would need to be collected. There is not a good way to use benefit transfer methods for the consumers' surplus although EPA is exploring one proposed by Bishop and Holt (2003). This approach at present does not look that promising. At present, it does not appear that the change in commercial landings will be sufficiently large to cause prices changes.

However, if additional information suggests price changes, existing data from California Department of Fish and Game and the National Marine Fisheries Service could be sufficient to estimate an inverse, general equilibrium demand curve (see Just et al. 2004 for a description) for the species in question. With these estimates, the benefits to consumers could be calculated.

2.3 Non-use Valuation

Because of the presence of delta smelt and Chinook salmon in the San Joaquin River it may be necessary to estimate non-use values. Specifically, under the Phase II Rule, non-use benefits should be estimated to a monetized value only "[i]n cases where the impingement or entrainment study identifies **substantial harm** to a threatened or endangered species, to the sustainability of populations of important species of fish, shellfish or wildlife, or to the maintenance of community structure and function in a facility's water body or watershed." (69 Fed. Reg. at 41648 (emphasis added)). "Substantial harm" establishes a high threshold for the need to monetize non-use values, and thus non-use values usually would not be included in the final analysis. The need to address non-use valuation will be made based on the extent to which delta smelt and/or Chinook salmon are found in the proposed impingement study.

If non-use values are needed, we would likely suggest using a benefit transfer method. There have not been any studies of non-use values associated with power plant activities *per se.* Generally such valuations have relied on studies associated with other types of activities. For example, EPA used a benefit transfers approach in its Proposal for the 316(b) regulations and in the related Notice of Data Availability (NODA). EPA (Tudor et al. 2003) reviewed numerous studies of use and non-use values that were associated with surface water improvements (their Appendix A). Of those shown, only three address both changes in fish populations and non-use values associated with them (Huang et al. 1997; Whitehead and Groothuis 1992; Olsen et al. 1991).

We propose considering these three studies in addition to doing a review of the recent literature. The recent literature may be important because EPA has placed some emphasis on this ecological valuation recently (see for example, “Valuation of Ecological Benefits: Improving the Science Behind Policy Decisions”, USEPA, 2004f).

In addition to these, there are several studies of salmon restoration actions that may be relevant. Pate and Loomis (1997) for instance, studied the value of restoration projects in the Sacramento River basin. Other studies (e.g., Bell et al. 2003) may also be relevant.

The results of this activity would likely be the development of a relationship (specifically a ratio) between use values and non-use values. For years, EPA used the 50 percent rule, a practice that implied that nonuse values were 50 percent of use values. Our approach, just like some of EPA's 316(b) efforts (Tudor et al. 2003), would be to refine this ratio for situations more comparable to the changes associated with power plant operations.

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Appendix D

Correspondence Regarding Agency Consultations

List of Attachments

Agreement between Pacific Gas and Electric Company (CCPP's previous owner) and California Department of Fish and Game for the Monitoring and Mitigation of Striped Bass in the Sacramento-San Joaquin Estuary dated 1995, and letter to CDFG from Mirant regarding Monitoring and Mitigation dated May 10, 2001.

California Endangered Species Act Memorandum of Understanding and Management Authorization between Pacific Gas and Electric Company and California Department of Fish and Game dated December 30, 1997

National Marine Fisheries Service Biological Opinion dated October 17, 2002

U.S. Fish and Wildlife Service Biological Opinion dated November 4, 2002

National Marine Fisheries Service letter to Mirant dated April 9, 2004

Mirant's Biological Assessment dated August 23, 2004

U.S. Fish and Wildlife Service letter to Mirant dated September 29, 2004

U.S. Fish and Wildlife Service letter to Army Corps of Engineers dated January 31, 2006

Army Corps of Engineers letter to U.S. Fish and Wildlife Service dated February 16, 2006

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